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MA22468

Decade Frequency Measuring Syst

Type XZA (1) BN 444

ROHDE & SCHWARZ
SALES CO. (U.S.A.), INC.
P. O. BOX 275
PASSAIC, N. J., U.S.A.

ROHDE & SCHWARZ

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Decade Frequency Measuring System

Type XZA (1)

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Note: Always quote the Type and Order Number (BN) in addition to the Serial Number (FNr.) of the set when asking for technical information and, in particular, when ordering repair parts.

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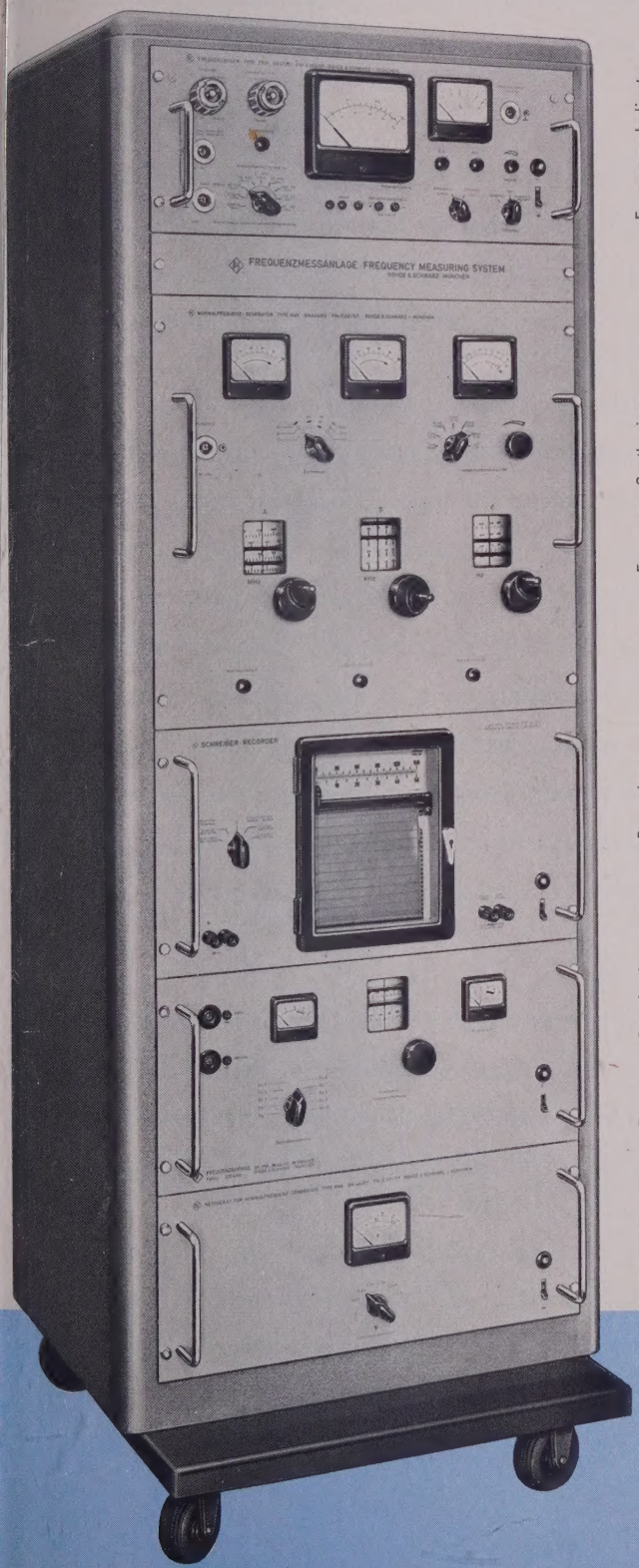
Type **XZA**

DECADE FREQUENCY MEASURING SYSTEM



10 cps to 1000 mc
Crystal-controlled
Accuracy 2 parts in 10^8

Frequency Measurement

10 cps to 500 kc
with direct indication

5 kc to 1000 mc
by heterodyning;
direct indication

frequency magnifier for 0.1, 1, 10, 100 kc

Frequency Generation

30 cps to 30 mc
by frequency synthesis

30 mc to 1000 mc
as harmonics

1 kc, 10 kc, 100 kc
as fixed frequencies

The picture shows the Decade Frequency Measuring System Type XZA expanded by a Recorder Type XMA and a Frequency Standard Type XSB.

HDE & SCHWARZ · MÜNCHEN

Data sheet
444 043

Printed in Western Germany

Uses

The Decade Frequency Measuring System Type XZA provides for precision frequency measurement and is easy to operate. Its range of measurement extends from sub-audio frequencies up to the region of kilomegacycles.

The unknown frequency is measured by heterodyning with a continuously adjustable reference frequency of high accuracy and stability. The reference frequency is derived by frequency synthesis from an internal, crystal-stabilized standard frequency. This frequency measuring system thus constitutes a signal generator of exceptional performance. The system is housed in a castered cabinet rack and can thus be easily moved to another place.

These features determine the typical applications of the Decade Frequency Measuring System Type XZA: frequency measurement on oszillators of each kind, such as transmitters, local oscillators, crystal stages, ultrasonic sound sources, and mechanical vibrators; study of the response of these frequencies to various influences such as time, temperature, loading, atmospheric pressure, humidity, or vibration; frequency-response recording with a built-in recorder or with separate recorders; study of passive two- and four-terminal networks of high selectivity, such as resonant circuits, electrical and mechanical filters, and receivers. Harmonics generated in the system with the same frequency stability are available for receiver calibration. Test and inspection departments use the decade frequency measuring system for example for production tests on crystal and measuring instruments. In radio-communication services it is often indispensable for the control and monitoring of transmitters frequencies or for the exact presetting of commercial receivers.

The advantages of the Decade Frequency Measuring System Type XZA are: exceptionally wide frequency range and high stability of the frequency indicator; a frequency magnifier for the indication of given frequencies with improved accuracy, in particular for measuring the centre frequency of frequency-modulated transmitters; a beat-frequency indicator for zero-beat adjustment, and an output for the connection of a recorder even of reduced sensitivity.

Moreover, provision has been made for the easy addition of ancillary equipment to meet extreme requirements for accuracy or for the expansion of the system to a complete frequency recording system.

Specifications

► Order Number BN 444043

Use as a frequency meter

Method	Direct measurement		Measurement by heterodyning with a reference frequency of 30 cps to 30 mc	
	Main meter	Magnifier		
Frequency range	10 cps to 500 kc, in 9 sub-ranges: 10 cps to 0.05/0.15/0.5/1.5/5/15/50/150/500 kc	100 kc ±3% (97 to 103 kc) 10 kc ±3% (9.7 to 10.3 kc) 1 kc ±3% (0.97 to 1.03 kc) 100 cps ± 3% (97 to 103 cps)	5 kc to 30 mc when heterodyning with the fundamental	30 to 1000 mc when heterodyning with harmonics
Accuracy	±1.5% of full-scale deflection	reading accuracy improved by a factor of 20 variations of 0.05% readable	equal to that of the driving standard frequency (see below) plus ±0.5 cps	±0.5 to 16.5 cps
Voltage range	0.1 to 10 v		0.1 to 10 v	0.1 to 3 v
Input, unbalanced	13-mm socket		13-mm socket	R&S connector Dezifix B
Result (high-impedance phones may be connected)	meter indication	indication on magnifier meter calibrated in per cent	reference frequency setting + difference frequency indication on meter difference frequency indication near 0 cps by beat-frequency indicator	reference frequency setting × harmonic order + difference frequency indication on meter order of harmonics can be read on meter

Frequency Recording with DC Recorder

Method, frequency ranges and voltage ranges are the same as mentioned above. Particularly suitable is the R&S Recorder Type XMA Order Number BN 444512D. It is ready for operation when, instead of the blank panel, it is inserted in the cabinet rack where the necessary wiring is provided.

Recorder output I/II for recorder and slave instruments of normal sensitivity, e.g. Type XMA or ZSG; half-wave rectification

Available direct current (average value) . . . . . max. 10 ma at full-scale deflection of meter, adjustable; proportional to frequency

Available d-c voltage (average value) . . . . . max. 3 v at full-scale deflection of meter, adjustable; proportional to frequency

Permissible impedance	less than 300 Ω for current recorder greater than 300 Ω for voltage recorder
Connectors I and II, switch-selected	4-mm telephone jacks or direct connection to Type XMA

Recorder output III for recorder or slave instruments of increased sensitivity; full-wave rectification

Available direct current (average value)	1 ma at full-scale deflection of meter; proportional to frequency
Permissible impedance	max. 10 Ω
Connectors	4-mm telephone jacks at the rear

Recorder output IV for recorder and slave instruments

Available direct current (average value)	40 µa at full-scale deflection of magnifier meter; proportional to frequency
Permissible impedance	250 Ω ±2%
Connectors	4-mm telephone jacks at the rear

Recorder or slave instruments must not be earthed.

Frequency Recording with Counter-type Frequency Meter

A separate pulse output provides for the connection of a frequency meter operating on the principle o the electronic counter. This gives direct digital frequency indication. The additional connection of a printer allows the sequence of figures to be recorded on a paper strip. Suitable R&S instruments are Electronic Counter Type FELZ BN 4735 and Printer Type DMA BN 47951.

Available voltage	approx. 1.5 V_{pp}, negative pulses
Permissible impedance	100 Ω or more
Connector	coaxial 13-mm socket; unbalanced

Use as a Generator of Variable Standard Frequency

Frequency range with stepwise adjustment	1 kc to 30 mc

Adjustment as the sum of two dial settings in steps of 100 kc and 1 kc (mc- and kc-dials)

Accuracy	equal to that of the driving standard frequency (see below)

Frequency range with continuous adjustment	30 cps to 30 mc

Adjustment as the sum of three dial settings (mc-, kc-, and cps-dials); mc-dial in 100-kc steps, kc-dial in 1-kc steps permit tuning to standard frequency with drift-cancelled oscillator.

Accuracy	equal to that of the driving standard frequency (see below) plus ±0.5 cps

Scale calibration	direct
Mc-dial, 0 to 30 mc	1 division per 100 kc
kc-dial, 0 to 100 kc	1 division per 1 kc
cps-dial, 0 to 1000 cps	1 division per 1 cps
Scale length	1.2 m each
Tuning indication	on meters by coarse adjustment to maximum deflection
Output	unbalanced; coaxial 13-mm socket
Output voltage	0.1 mv to 1 v open circuit, sinusoidal, adjustable in accurately-known steps, source impedance 60 Ω
Accuracy	±2 db
Attenuator setting	6 10-db steps and continuous
Indication of attenuator input voltage	on meter calibrated in volts and decibels
Non-harmonic spurious signals	down more than 60 db
Distortion	less than 10 %
Output for harmonics	unbalanced; R&S connector Decifix B
Output voltage	30 to 1000 mc, 2.5 to 0.5 mv
Fixed frequencies additionally available	1 kc, 10 kc, 100 kc
Accuracy	equal to that of the driving standard frequency (see below)
Output voltage	approx. 1 v open circuit, sinusoidal, source impedance approx. 150 Ω
Spurious modulation	down more than 60 db
Distortion	less than 5 %
Output, in rear	unbalanced; coaxial 13-mm socket
Drive of the System	internal or external
Internal drive	from built-in 100-kc crystal oscillator
Frequency variations due to external influences	less than 2 to 8 parts in 10^8

The value of 2 parts in 10^8 applies to most favourable operating conditions as ensured by the type of installation, ambient temperature, supply fluctuations, uninterrupted operation, etc.

Mean daily frequency drift	
after a service time of 10 days	less than 5 parts in 10^8 per day
after a service time of 100 days	less than 2 parts in 10^8 per day
Warm-up period for an accuracy better than 1 part in 10^6	60 minutes, approx.
External drive	
Driving standard frequency required	100 kc sinusoidal, 1 v into 1 kΩ
Input, in rear	unbalanced; coaxial 13-mm socket

Input for Frequency Synthesizer Type XUB

serves to feed in the variable frequency 10 to 9 kc (1 v into 10 kΩ) from the Frequency Synthesizer Type XUB; see "Ancillary Equipment"!

General Data

Power supply . . . . . 115/125/220/235 v, 47 to 63 cps (500 va)

Permissible ambient temperature . . . . . +15 to +35° C

Units of the System BN 444043 — Valve Complement / Dimensions / Weight

Unit	Designation	Type	Order Number	Valve Complement	Dimensions	Weight
1	Frequency Indicator	FKM	BN 47051 D	4 x EAA 91, 5 x ECC 81, 1 x ECH 81, 4 x EF 80, 2 x EF 800, 4 x EL 86, 2 x 85 A 2	520 x 202 x 382 mm	19 kg
2	Frequency Synthesizer	not supplied separately		1 x E 88 CC, 8 x ECH 81, 36 x EF 80, 5 x EF 800, 3 x E 80 L	520 x 474 x 428 mm	50 kg
3	Blank panel	space provided for insertion of Recorder Type XMA BN 444512 D				
4	Blank panel	space provided for insertion of Frequency Standard Type XSB BN 444112 D				
5	Power Supply	not supplied separately		2 x EF 800, 6 x EL 34, 2 x 85 A 2	520 x 202 x 339 mm	31 kg
Complete System	Decade Frequency Measuring System	XZA	BN 444043	4 x EAA 91, 5 x ECC 81, 1 x E 88 CC, 9 x ECH 81, 40 x EF 80, 9 x EF 800, 6 x EL 34, 4 x EL 86, 3 x E 80 L, 4 x 85 A 2	600 x 1636 x 640 mm	180 kg

Various connecting cables, patch cords, connectors and a trimming tool are included in the Order Number BN 444043.

Description

A standard frequency of 100 kc is obtained from a crystal housed in an oven or it may be applied from an external source. A great number of harmonics of 100 kc and 1 kc are derived by frequency division and distortion. Any 100-kc or 1-kc harmonic can be taken from these spectra and, by adding an interpolation frequency continously variable from 0 to 1 kc, any output frequency between 30 cps and 30 mc is obtainable. Its value is the sum of the readings of three dials which are calibrated in mc, kc, and cps, respectively. The system operates on the principle of frequency synthesis. It provides for a sinusoidal output signal, of highly accurate frequency and good stability, which is adjustable in amplitude and virtually free from spurious responses. Harmonics of the fundamental output frequency are provided by another harmonic generator for the range above 30 mc up to more than 1000 mc. They are available at a separate output.

When the system is used as a heterodyne frequency meter, the output frequency serves as reference frequency. The unknown frequency is heterodyned with the standard frequency in a broadband mixer and the resulting difference frequency can be read directly on a meter; in addition it can be aurally monitored, a feature which is useful for checking purposes or for increasing the voltage sensitivity. When the difference frequency is reduced to zero or to low integer value by varying the reference frequency, the unknown frequency can be read from the dials in direct succession. To search for an unknown frequency, the mc- and kc-dials, which normally permit stable tuning at 100-kc and 1-kc intervals, respectively, can be continuously tuned through the entire frequency range, the wide scale range of the frequency indicator facilitating rapid determination. In measurements above 30 mc, the reference frequency is first adjusted to zero beat and then varied by a kc-step to determine the order of the harmonic used; the frequency indicator then directly reads the number by which the scale reading must be multiplied.

Remote measurement of a transmitter frequency can be carried out in conjunction with a receiver, which need not meet special requirements. The signal picked up by the aerial is heterodyned in the receiver with the output frequency of the system or, above 30 mc, with its harmonics. The difference frequency is

en produced in the receiver; after it has been reduced to zero the unknown frequency can be read s described above. The harmonic number can be determined from the receiver calibration. Adjustment or zero beat is facilitated by using the beat-frequency oscillator of the receiver, especially in the case f amplitude-modulated or keyed transmissions. In the case of frequency-modulated transmitters the ifference frequency is adjusted so as to be greater than the frequency deviation and then applied to ne frequency indicator; thus the frequency reading, i. e. the centre frequency, is not affected by the nodulation. The accuracy for the measurement of the difference frequency is still enhanced by the use of he frequency magnifier.

On the other hand, comparison with a standard frequency emission permits the built-in crystal to be hecked and corrected, if necessary. The calibration of the interpolation oscillator can be checked in the ystem itself.

For frequencies up to 500 kc, the frequency indicator can be used directly; thus high measurement accuracy is obtained even at low frequencies. In all types of measurement the frequency indicator also affords the possibility of observing frequency variations on the indicating meter, the discrimination being adjustable between wide limits by the choice of a suitable difference frequency. Direct currents proportional to the reading can be fed to a recorder for frequency recording.

The system is largely insensitive to a-c supply and temperature fluctuations. The thermostat for the crystal is so designed that almost full measurement accuracy is attained after a short warm-up period.

The complete system is housed in a stable, castered cabinet rack. The individual rack-mounting units comply with the German standard DIN 41490. On top, the frequency indicator contains the indicator section, the necessary mixers, and the harmonic generator producing the harmonics above 30 mc. Below it follows the frequency synthesizer, which combines the master crystal oscillator and the circuitry for frequency dividing and frequency synthesis. The power supply is located at the bottom.

Space is reserved and provisions are made in the cabinet rack for later addition of two ancillary units, namely a recorder and a frequency standard.

Ancillary Units

Recorder Type XMA BN 444512 D for frequency recording in conjunction with the Frequency Indicator Type FKM.

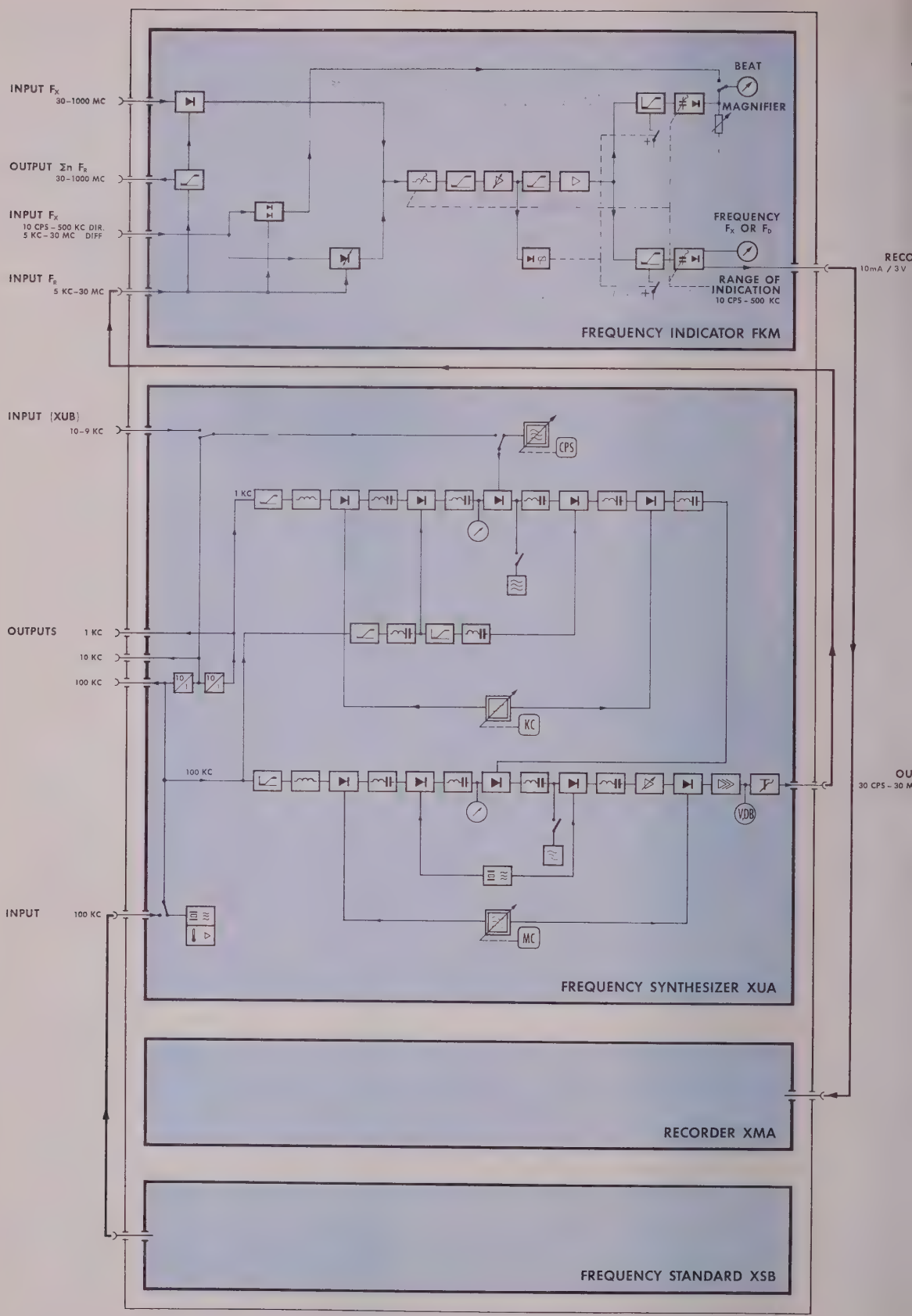
Frequency Standard Type XSB BN 444112 D for external control of the frequency synthesizer. the very high accuracy of the frequency synthesizer can still be increased by a power of ten if the Frequency Standard Type XSB is added to the Decade Frequency Measuring System Type XZA.

Ancillary Equipment

Combination with the Frequency Synthesizer Type XUB. The error component of ± 0.5 cps due to the cps-dial may be reduced to ± 5 millicycles by using the Frequency Synthesizer Type XUB BN 444465. This synthesizer for low frequencies has two dials, one of which permits stable tuning in steps of 10 cps while the other is continuously variable over a 10-cps range. The Type XUB substitutes the cps-dial of the Decade Frequency Measuring System Type XZA when both equipments are combined.

Improvement of the sensitivity is possible by connection of an amplifier. Suitable types are: Type UVN BN 12001 (10 cps to 100 kc), Type UVM BN 12011 or BN 12012 (20 cps to 1 mc) Type UVH BN 12021 or BN 12022 (30 cps to 30 mc), Type ASV BN 1372 (30 to 300 mc).

Extension of the frequency range toward higher frequencies (single output frequency up to 300 mc, harmonics and frequency measurement up to the order of kmc) is possible with the Times-Ten Frequency Multiplier Type XVD BN 444421 (3 to 30 mc transferred to 30 to 300 mc).



Block diagram of the Decade Frequency Measuring System Type XZA

We reserve the right to make any departures from this specification, especially those considered desirable for reasons of improved design.

Instruction Book

FREQUENCY MEASURING SYSTEM

Type XZA

BN 444041 BN 444042

Note: Always quote the Type and Order Number (BN) in addition to the Serial Number (FNo) of the set when asking for technical information and, in particular, when ordering repair parts.

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1 Specifications

Components of the Decade Frequency Measuring System BN 444042

Frequency Indicator	Type FKM BN 4705 D
Frequency Synthesizer	Type XUA BN 444461 D
DC Recorder	Type XMA BN 444511 D
Midget Crystal Clock	Type XSZ BN 444211 D
Power Supply	Type XNA BN 444911 D
mounted in Cabinet Rack . . .	Type NG 4

In model BN 444041, the Recorder is not included but can be built in at a later period.

Use as Frequency Generator of High Accuracy

Outputs for fixed frequencies .	unbalanced; 13-mm jacks
Output frequencies	100 kc, 10 kc, 1 kc, 100 cps, 50 cps, seconds contact
Accuracy	1 part in 10^7 +)
Output voltage	1 v each, output impedance 150 Ω
Spurious modulation	better than 60 db down
Harmonic content	less than 5 %
Output for one variable frequency	unbalanced; 13-mm jack
Frequency range for stepwise tuning	1 kc to 30 mc, adjustable as the sum of 2 scale settings in steps of 1 kc and 100 kc (mc and kc scales)
Accuracy	1 part in 10^7 +)

Frequency range for continuous tuning	30 cps to 30 mc, adjustable as the sum of 3 scale settings (cps, kc and mc scales); 2 scales lockable with standard frequency
Length of scales	1.2 m (4 ft.) each
Accuracy	1 part in 10^7 ± 0.5 cps +)
Output voltage	0.1 mv to 1 v in accurately-known settings, output impedance 60 Ω
Spurious signals	better than 60 db down
Harmonic content	less than 10 %
Harmonics	up to 600 mc derivable with approx. 0.5 mv

Use as Frequency Meter

Direct Frequency Measurement with Frequency Indicator

Range	30 cps to 500 kc in 9 ranges (30 cps to 0.05/0.15/0.5/1.5/5/15/50/150/500 kc)
Accuracy	± 2 % of reading
Voltage range of unknown frequency	0.1 v to 10 v, unbalanced; 13-mm jack

Difference Frequency Measurement, Frequency Synthesizer being the Source of a Variable Comparison Frequency

Measuring range	30 cps to 30 mc
Accuracy	1 part in 10^7 ± 0.5 cps +)
Voltage range of unknown frequency	0.1 v to 10 v, unbalanced; 13-mm jack
Indication of difference frequency or zero adjustment .	by Frequency Indicator

Rot

Difference Frequency Measurement, Frequency Synthesizer being the Source of a Variable Comparison Frequency (Measuring with Harmonics)

Measuring range	30 mc to 600 mc
Accuracy	1 part in 10^7 ± 10 cps +)
Voltage range of unknown frequency	0.1 v to 3 v, unbalanced; 13-mm jack
Indication of difference frequency or zero adjustment	by Frequency Indicator

Measurement with Suitable Receiver

Measuring range	up to 30 mc
Accuracy	1 part in 10^7 ± 0.5 cps +)
Voltage range of unknown frequency	depending on type of receiver
Admissible modulation	A0, A1, A2, A3, F1, F3

Measurement with Suitable Receiver (Measuring with Harmonics)

Measuring range	30 mc to 600 mc
Accuracy	1 part in 10^7 ± 10 cps +)
Voltage range of unknown frequency	depending on type of receiver
Admissible types of modulation	A0, A1, A2, A3, F1, F3

Use as Frequency Recorder

Nominal range of unknown frequency	30 cps to 600 mc
Recording range for frequency variations	50 cps to 500 kc in 9 ranges (50/150/500 cps/1.5/5/15/50/150/500 kc)

Recording width	120 mm (4¾")
Paper speed	20/60/120 mm/hr by 50-cps synchronous motor; other speeds or clockwork drive on request
Recording	inkless

General Data

Tube complement	tubes of the noval or miniature type
Power supply	220 v ± 10 %, 40 to 60 cps (about 600 va); adaptable to 110/125/150 v
Dimensions, over projections	600 x 1700 x 640 mm (23¾" x 62" x 25¼") castered cabinet rack according to DIN 41491 (R&S Type NG 4)
Weight	182 kg (400 lbs.) (BN 444041) 194 kg (428 lbs.) (BN 444042)

+) The accuracy is determined by the Midget Crystal Clock XSZ; it is given as a mean value and can easily be maintained or even exceeded with this set suitably controlled. For details refer to data sheet 444211.

2 Purpose and Application

The decade frequency measuring system contains all units necessary for precision frequency measurements and recording, in a handy and carefully designed combination. The measuring method used is based upon the generation of one single variable standard frequency of high accuracy and stability. Thus the assembly is at the same time a signal generator of unexcelled qualities.

It is to these properties that the essential applications of the frequency measuring system can be traced back: On the one hand, this assembly permits measuring the frequency of each type of oscillators (transmitters, mechanical vibrators, quartz crystals, etc.) and determining the response of their frequencies to various influences; on the other hand, this setup suggests itself for use wherever the need is for accurately-known frequencies, above all for examination of selective components and circuits, such as oscillating circuits, electric and mechanical filters, receivers, etc. The application of the Decade Frequency Measuring System is not confined to development work only; in the test department and incoming inspection the assembly is useful for production checks on test sets, quartz crystals, and so forth. Furthermore it is useful in the traffic section, for presetting of communication receivers or monitoring of transmitter frequencies.

3 Function and Construction

The system functions as a heterodyne-type frequency meter, forming the difference frequency of the unknown frequency (x) and a known reference frequency (v):

$$f_x - f_v = f_d \qquad (1)$$

$$f_x = f_v + f_d \qquad (2)$$

If the difference is brought to zero by adjusting the reference frequency, the latter directly furnishes the value of the unknown frequency:

$$f_x = f_v \qquad (3)$$

Sometimes it may be convenient to adjust the difference to a certain fixed value f_{dk} which must then be added to the reference frequency:

$$f_x = f_v + f_{dk} \qquad (4)$$

If an unknown difference f_{dx} is allowed to remain, this difference must be determined accurately; generally it is by several orders lower than the unknown frequency and can thus be measured much more easily than the latter:

$$f_x = f_v + f_{dx} \qquad (5)$$

This is especially true if f_{dx} is extremely reduced by beating it with a fixed frequency f_{dk} :

$$f_x = f_v + f_{dk} + f_{dx} \qquad (6)$$

Like all heterodyne methods this procedure is firstly based on the physical fact that the difference note between two frequencies is obtained with mathematical accuracy and without an additional error, and secondly on the experience that the identity of two frequencies can be determined with high accuracy by measuring instruments. This holds also for the harmonics of a distorted reference frequency:

$$f_x - k \cdot f_v = f_d \qquad (7)$$

This permits the measuring range to be expanded considerably, if suitable means are provided for determining the order k of the harmonic used.

If the instruments used for measuring the difference frequency f_d are of the integrating type, like the frequency indicators, the methods based on the equations (2), (4), (5), and (6) permit determining the center frequency of f-m oscillations, defined as the arithmetical mean of all frequencies generated by the modulation during a certain period of time.

The superiority of the system over other equipments functioning on the same physical principles lies in the generation of a highly accurate, freely selectable single reference frequency by novel means. Thus the accuracy is by far better than the one of the usual heterodyning frequency meters; in contrast with the methods using spectra, complete unambiguousness is ensured.

The units of the system solve the above problems in the following manner:

The frequencies 100 kc, 10 kc, and 1 kc are generated with high accuracy in the Midget Crystal Clock Type XSZ BN 444211 and converted by the Frequency Synthesizer Type XUA BN 444461

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in conjunction with the Power Supply Type XNA BN 444911 into a single, continuously variable frequency (f_v) of the same accuracy; this frequency is practically free from any spurious frequencies.

The Frequency Indicator Type FKM BN 4705 serves the mixture with the unknown frequency (f_x) and the indication of the difference frequency (f_d). Furthermore it generates the harmonics of the reference frequency which multiply the total measuring range, obtainable with the fundamental frequency, by twenty. Thanks to the integrating method, it is also possible to measure f-m oscillations.

The current passing the meter of the Frequency Indicator can be additionally fed into a Recorder Type XMA BN 444511 (built into the System BN 444042 only) for tracing frequency variations. Discrimination and paper speed can be widely adapted to the specific purpose.

All units of the system can as well be used individually. This holds especially for the Frequency Synthesizer XUA when controlled by the Midget Crystal Clock XSZ and used as a signal generator of extreme setting accuracy and stability.

The sets are slide-in units built to German standards DIN 41490 and accommodated in a castered cabinet rack according to DIN 41491 with blowers. The cabinet rack contains the necessary wiring except that the connections are made through coaxial plug-in cables with an eye to the different measuring possibilities. Elastic multipoint connectors which engage automatically when the units are slid in, serve the connection between the units and the rack wiring. A wiring diagram is enclosed in the appendix.

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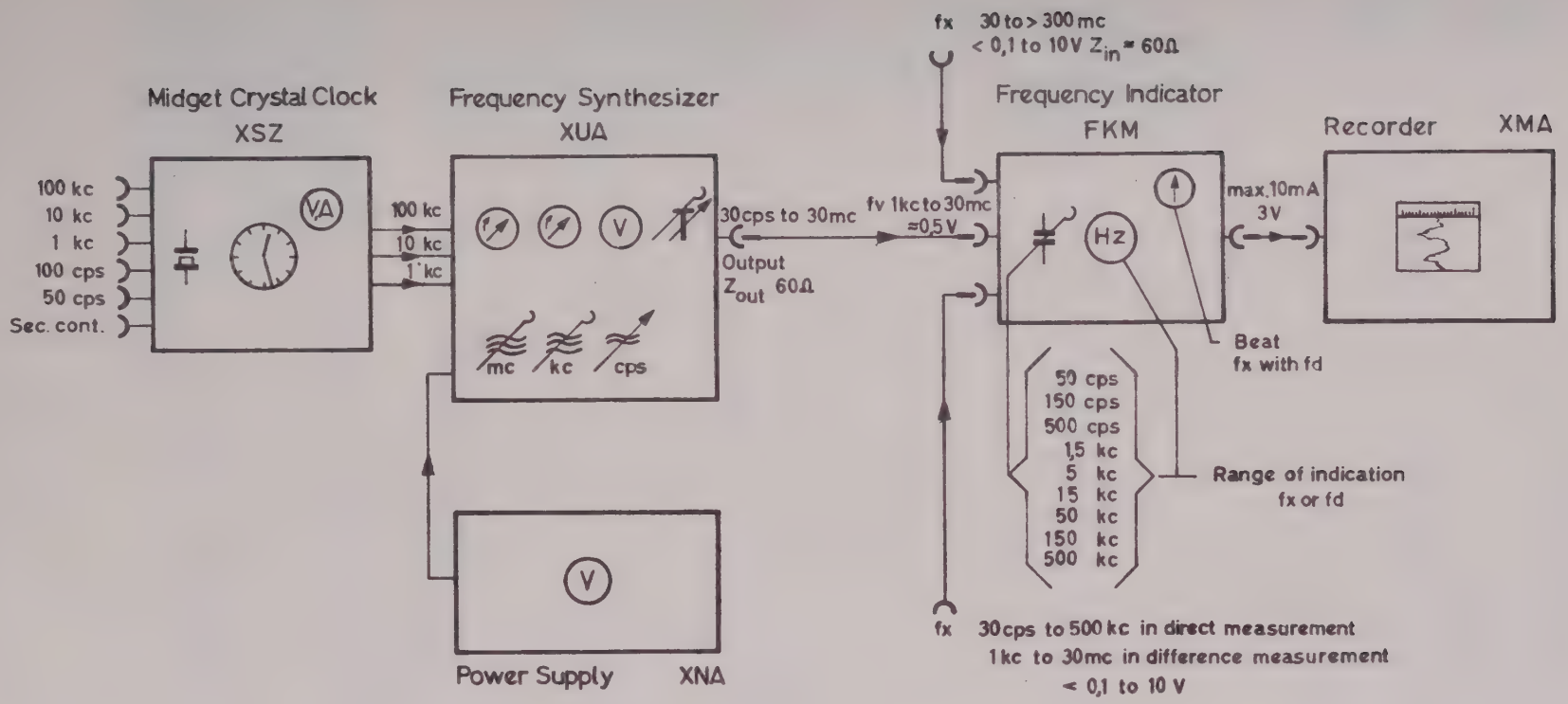

Frequency Measuring System BN 444042

4 Operating Instructions

4.1 Preparations

The equipment is provided with casters which can be easily removed for fixed use of the system. Pull the wheels down against the resistance of a locking spring; on later models it is necessary to loosen four screws.

Connect the assembly to a mains voltage of 220 v ± 10 %, 40 to 60 cps through the cable delivered with it; the power consumption is about 600 va. The mains connector with separate neutral conductor is at the r.h. side over the floorboard. The wing nut at the l.h. side on the floorboard serves the ground connection.

The system can be operated also on 110, 125, or 150 volts. To this end put the fuses in the individual units into the proper clips according to the inscriptions. In the Midget Crystal Clock XSZ and the Frequency Indicator FKM the original fuses can be used; the fuses of the Power Supply XNA should by no means differ from the ratings given for each mains voltage (see inscriptions or Table of Replaceable Parts). The connections of the transformer for the blowers should also be changed correspondingly. The Recorder XMA has been laid out for 220 volts only. Adapter transformers for higher voltages are obtainable upon special order.

4.2 Midget Crystal Clock Type XSZ

4.21 Putting into Operation

The set is put into operation with the aid of the mains switch S4 in the lower right-hand corner. The pilot lamp R11 over S4 will then light up. The movement Mo1 starts automatically as soon as the tubes have warmed up. To adjust the movement for the correct time the lid covering the movement should be opened

by moving it to the left. The minute- and hour-hands are friction-tight as usual and can be manually adjusted at will whereas this is impossible with the sweep-hand. By pressing the button below the dial, the latter should be stopped when on "60", until a full minute is reached.

Note: The reference numbers S4, R11, Mo1, etc. refer to the circuit diagram of the unit in question.

4.22 Outputs

At the output jacks on the l.h. side, the specified frequencies appear as sinusoidal waves of about 1 v with the accuracy of the crystal frequency. These outputs can be loaded arbitrarily without any reaction whatever. With the set used as a unit of the Decade Frequency Measuring System, the rear parallel outputs for 1, 10, and 100 kc are additionally taken to the Frequency Synthesizer via the wiring harness of the rack. The lowest jack is connected to a contact S2 closed by the movement each second for about 1/10 sec. This contact can be employed for time measurements.

The crystal frequency variation during the warm-up period of the oven is about 2 parts in 10^5. It is recommended to keep the Midget Crystal Clock in continuous operation since full warming-up will require several hours. Interruptions not exceeding a few minutes, however, do not affect the frequency.

4.3 Frequency Synthesizer Type XUA with Power Supply Type XNA

4.31 Putting into Operation

The mains switch S1 on the Power Supply XNA serves to put the set into operation. The connection to the Frequency Synthesizer is ensured via the wiring harness of the rack.

4.32 Adjusting the Output Frequency

The three drum scales marked A, B, C serve the adjustment for a desired output frequency of the Frequency Synthesizer. The values read on the scales are to be added progressively. The selector switch S1 above the scales indicates the respective function of the individual scales. The symbol ◯ (OFF) denotes that the associated scale is inoperative, i.e. that the output frequency is independent of the position of the scale; the symbol ▬ (CONTINUOUS) indicates that the frequency is continuously variable with the associated scale, though only with its inherent accuracy; the symbol ⫿⫿⫿ (LOCKED) means that it is only the single frequencies associated with the scale divisions that are obtainable with the accuracy of the applied standard frequency.

If the frequency to be adjusted is given, this selector switch should be put to the third position from the left (A ⫿⫿⫿, B ⫿⫿⫿, C ▬). The scale A is to be adjusted to the associated multiple of 100 kc and tuned to the maximum deflection of the meter I1 above it. Subsequently the scale B and the meter I2 are used to tune to the associated 1-kc multiple in the same manner. Scale C serves to set the last figures of the desired frequency. The frequency now appearing at the output is the sum of the values read on the individual scales.

If it is intended to adjust only to a multiple of 1 kc but with the full accuracy of the standard frequency, the selector switch should be thrown to its fourth position from the left (A ⫿⫿⫿, B ⫿⫿⫿, C ◯), the scale C thus becoming ineffective. In all other respects the procedure is the same as described above.

If the frequency is required to be continuously variable over a range of 100 kc, the selector switch should be thrown to its second position (A ⫿⫿⫿, B ▬, C ◯). The scale B then permits

the frequency to be varied continuously, the inherent error of about 300 cps of this scale then being effective; scale A remains on one of the locking settings as in the preceding cases.

In the first position of the selector switch (A [redacted], B ◯, C ◯), the entire frequency range of 30 mc is continuously variable with scale A, the other two scales then being inoperative. Here the accuracy is better than about 30 kc.

Setting the scales for a frequency measurement in conjunction with the Frequency Indicator FKM is described under 4.4.

With the adjustment being complete, the smoothly operated drive can be locked by putting the lever knob under each scale to a horizontal position.

The small knobs below each scale, provided for the zero adjustment on the individual scales (see 5.22), should not be turned during operation.

4.33 Adjusting the Output Voltage

The open-circuit voltage can be continuously varied in the ratio 10 : 1 by means of the control R431 and further reduced in 10-db steps with the switch S2. This voltage is read on the r.h. meter I3. The upper inscriptions of the step switch (mv) hold for the two upper scales (full deflection 1 v, for reading 1 v, 100 mv, 10 mv, 1 mv or full deflection 0.3 v, for reading 300 mv, 30 mv, 3 mv, respectively), while the reading taken on the lower scale should be added to the lower inscriptions of the step switch if the db calibration is used (0 db = 0.775 v).

Furthermore it should be borne in mind that the open-circuit voltage at the output will drop by about -5.5 db without load and by about -0.3 db with a 60-Ω load, when a switchover is made

from the step 0 db to the step -10 db. Hence, this voltage should be readjusted with the continuous control. Sets bearing the serial numbers KL 30/... will show a voltage drop of -4 db when terminated in 60 Ω.

The output impedance of the Frequency Synthesizer XUA is 60 Ω independent of the switch position. The voltage across the output terminals depends on the ratio of the output and load impedance according to well-known laws and will fall to half the value of the open-circuit-voltage reading, if terminated in 60 Ω.

Harmonics of the frequency set on the Frequency Synthesizer XUA appear at the upper l.h. jack of the Frequency Indicator FKM with an order higher than 20 and can be derived there as a spectrum at a level of more than 0.5 mv for measuring purposes. To this end, connect the output jack of the Frequency Synthesizer XUA to the middle input jack of the Frequency Indicator FKM by means of a coaxial cable delivered with the system. The voltage controls of the Frequency Synthesizer XUA should be set for 1 v output voltage.

4.4 Frequency Indicator Type FKM

4.41 Putting into Operation

The set is put into operation with the aid of the mains switch S3 in the lower r.h. corner. The pilot lamp R11 above the switch will then light up. The set is ready for operation after the necessary warm-up period for the tubes.

4.42 Direct Frequency Measurement

In this case the unknown frequency f_x which may be between 30 cps and 500 kc is read directly, and without employing any reference frequency f_v, on the l.h. meter FREQUENCY (I1). The r.h. meter BEAT (I2) is not used.

Throw the switch MEASURING RANGE F_X to DIRECT MEASUREMENT. It just shifts the lettered ring round the switch S1 RANGE OF INDICATION which, in this case, indicates that all ranges can be used except one of the two 500-kc ranges.

The unknown frequency f_x is applied to the lowest jack; from 0.1 v to 10 v the voltage of this frequency does not affect the indication in any way; likewise, even a considerable distortion of the waveform remains ineffective. If the input voltage drops below the permissible minimum, the meter is cut out so that faulty measurements due to undervoltage are precluded. Likewise, there will be no indication, if one has selected too low a measuring range since the built-in filters hinder the voltage from passing to the indicator section. False settings of the RANGE OF INDICATION switch will not damage the meter either.

It is recommended in each case to select the lowest range of indication consistent with the value to be measured to draw full benefit from the accuracy of the set.

If the unknown frequency f_x is frequency modulated, the Frequency Indicator FKM reads the center frequency which is defined as the arithmetical mean of the frequency band covered. The range of indication should be chosen high enough so that the highest frequency arrived at, viz. center frequency + frequency deviation, or, to be more precise, the upper modulation side bands, remain below the limit marked red as PERMISSIBLE MINIMUM F_X OR F_V.

4.43 Frequency Measurement in Conjunction with the Frequency Synthesizer XUA (Heterodyning Method) for $F_X < 30$ MC

The unknown frequency f_x that may lie between 30 cps and 30 mc is mixed in the Frequency Indicator FKM with a reference frequency f_v which is derived from the Frequency Synthesizer XUA

and varied according to the equation (3) page 10 until the difference frequency f_d directly read on the l.h. meter FREQUENCY of the Frequency Indicator FKM becomes zero. The zero beat is indicated on the r.h. meter. The scale reading on the Frequency Synthesizer XUA then immediately yields the value of the unknown frequency. If the latter is not stable enough for a satisfactory zero adjustment, a finite frequency difference f_{dx} adequate to the instability should be left, read on the Frequency Indicator FKM and added to the reading of the Frequency Synthesizer according to equation (5) page 10.

The unknown frequency is applied to the lower l.h. jack F_X of the Frequency Indicator FKM. Its voltage may be between 0.1 and 10 v. The output frequency of the Frequency Synthesizer XUA is applied to the middle jack F_V of the Frequency Indicator FKM through a coaxial cable delivered with the system. Its voltage is set to about 0.5 v.

The switch MEASURING RANGE is to be put to the frequency setting corresponding to the frequency under test f_x in the section MEAS. OF DIFFERENCE FREQ. The letters A, B, C appearing at the ring indicate which ranges of indication should be used on the Frequency Indicator FKM with the scales A, B, C of the Frequency Synthesizer XUA being used successively.

There are the following cases:

4.431 500 KC < F_X < 30 MC

If the unknown frequency f_x is higher than 500 kc but lower than 30 mc, the switch RANGE OF INDICATION should first be put to the second switch position (500 kc) corresponding to the position of the letter A. The selector switch on the Frequency Synthesizer XUA should be brought to the first position and the adjustment of the scale A be varied, beginning from 400 kc, until

the l.h. meter of the Frequency Indicator FKM suddenly deflects thus indicating that the reference frequency f_v has approached the unknown frequency f_x to about 400 kc. This deflection f_d is minimized (vicinity of zero) by further adjustment of A. A reading will be obtained only at one point of the scale A since harmonic mixtures in the Frequency Indicator FKM are automatically suppressed. Subsequently, the selector switch should be turned clockwise by one step and the next lower division of the scale A be adjusted to by turning the knob counterclockwise, as set forth under 4.32.

Now it is necessary to select the RANGE OF INDICATION B (150 kc); the Frequency Indicator FKM will then read a value f_d between 0 and 100 kc. By adjustment of scale B the indication should then be brought to zero in the same manner and tuned to the next lower division after the selector switch has been turned to its next position. After passing over to the range of indication C (1.5 kc), one obtains a deflection f_d between 0 and 1 kc which is to be reduced by scale C until the needle of the r.h. meter BEAT begins to vibrate at the residual difference frequency. Adjust scale C, while observing this beat, until a beat cycle of much more than 1 second is arrived at ($f_d \ll 1$ cps). The readings on the 3 scales of the Frequency Synthesizer XUA will then directly yield the unknown frequency ($f_x = f_v$).

4.432 10 KC < Fx < 500 KC

If the unknown frequency f_x is within the range 10 kc to 500 kc, it can be determined directly, as set forth under 4.42, in the range of indication marked A. To do so, it is necessary to remove the output voltage of the Frequency Synthesizer XUA; this can either be done by interrupting the cable connection or by backing off the output voltage control. Then the scale A is locked on the next multiple of 100 kc below the approximate result f_x thus

obtained and the output voltage again applied to the Frequency Indicator FKM. If a frequency of, say, 225 kc is read on the Frequency Indicator FKM the scale A will come to a standstill on the division 0.2 mc; if the indication is below 100 kc, the scale will be locked on 0.0. Now the switch RANGE OF INDICATION should be put to position B; generally, the deflection will then disappear. With an adjustment made on scale B the deflection f_d will suddenly reappear and should then be reduced to zero. The adjustment of scale C should be performed as set forth under 4.431.

4.433 1 KC < F_X < 10 KC

If the frequency under test is in the range between 1 kc and 10 kc, scale A should be locked on division 0.0 from the beginning. Subsequently, the frequency under test f_x is measured directly in position B and without the output voltage from the Frequency Synthesizer (4.42). On the basis of the result, scale B should be locked on the next lower multiple of 1 kc. The adjustment of scale C is performed as described above, but in the range of indication of 500 cps.

4.434 30 CPS < F_X < 1 KC

If the direct measurement according to 4.42 shows that the frequency under test is lower than 1 kc, the scales A and B should be locked on division 0.0. For the adjustment of C it is just necessary to observe the meter BEAT; the indicating meter, in this case, reads the frequency f_v of the Frequency Synthesizer XUA and not the difference frequency f_d.

4.44 Frequency Measurement in Conjunction with the Frequency Synthesizer XUA (Beat with Harmonics) with F_X > 30 MC

The measurement is performed as set forth under 4.431; however, harmonics of the output voltage of the Frequency Synthesizer XUA,

whose order k is not yet known at the beginning of the measurement, are used as a reference frequency f_v (equation (7), page 11). The unknown frequency f_x with an admissible voltage of 0.1 to 3 v is applied to the upper l.h. jack F_X of the Frequency Indicator FKM where sufficiently strong harmonics of f_v appear up to at least 600 mc. The switch MEASURING RANGE should be on > 500 KC. Starting at 30 mc in the RANGE OF INDICATION A, one turns the scale A of the Frequency Synthesizer XUA. The first position thus reached and yielding a deflection f_d on the Frequency Indicator FKM is generally used for the measurement. The scales A, B, and C are now adjusted as discussed above for the range > 500 KC. The meter BEAT of the Frequency Indicator FKM is not operative during the measurement with harmonics. Corresponding to the use of harmonics of f_v the difference frequency changes more quickly by the order k of the harmonics; this must be taken into account with respect to the speed of the adjustment, particularly in the case of scale A. When tuning the scales B and C one obtains a deflection on the Frequency Indicator FKM over a portion of their ranges only.

If it is intended to determine the order k of the harmonic of f_v used, the setting of scale B should be shifted by one division after the above adjustment

$$f_x - k \cdot f_v = 0$$

has been made. In the range 15 kc of the Frequency Indicator FKM, the change of the difference frequency thus effected

$$f_d = f_x - k\ (f_v \pm 1\ \text{kc}) = k_{(\text{kc})}$$

should be observed. The value of the indication in kilocycles directly yields the harmonic k employed. If the indication is, say, 6 kc use has been made of the sixth harmonic. With the

stability of the frequency under test being very poor, it is preferable to adjust the E scale by 10 divisions and to observe the shift in multiples of 10 kc within the 150-kc range; in this case, the influence of the instability is ten times smaller. The test result is obtained by multiplying the reading on the scales of the Frequency Synthesizer XUA by the order of the harmonic

$$f_x = k \cdot f_v.$$

4.45 Observing Frequency Variations

If it is intended to monitor the variation of a frequency, it is necessary to detune the Frequency Synthesizer XUA from the unknown frequency downward by an amount that corresponds to the anticipated variation, and to select the suitable range of indication on the Frequency Indicator FKM. In the measurement of low frequencies care should be taken to ensure that the frequency of the Frequency Synthesizer XUA does not become lower than the minimum reference frequency marked red for each range of indication. Otherwise, the frequency of the XUA would be indicated itself.

4.46 Measurement of Frequency Modulated Oscillations

Besides the direct measurement according to 4.42, frequency modulated oscillations can be studied according to one of the heterodyning methods 4.43, 4.44, or 4.45. One should proceed according to equations (2), (4), (5), and (6), page 10, i.e. not tune to the difference frequency 0, but to a finite value. The reference frequency f_v should be set on the Frequency Synthesizer XUA so much below the center frequency that the conditions set forth under 4.42 for measurements at frequency modulation are here fulfilled for the difference frequency f_d. This method is also recommendable whenever an unwanted frequency modulation is present.

Rot

4.47 Increase of Sensitivity

The voltage sensitivity is limited to values below 0.1 (generally about 0.02 to 0.05 v; "< 0.1 V") for all measurements here described, by the automatical cutoff of the meter INDICATION in the Frequency Indicator FKM, mentioned under 4.42. If a direct indication is not necessary, a considerably increased sensitivity can be obtained by monitoring the difference frequency by means of a headphone (4000 Ω) connected to the Frequency Indicator FKM. The measuring accuracy, however, is in this case somewhat lower than with the built-in meters; this is due to the low-frequency cutoff of the headphone and the ear. Therefore, this method should be preferably used at very high frequencies.

A further increase of sensitivity can, of course, be achieved by a corresponding preamplification of the unknown frequency f_x. To this end test amplifiers are recommended such as our Types UBM, UVH, and UVM. They can simply be connected between the frequency source to be studied and the f_x input of the Frequency Indicator FKM.

As for using receivers to increase the sensitivity in stationary measurements refer to 4.6.

4.5 Recorder Type XMA

The current flowing through the indicating meter of the Frequency Indicator FKM during observation of the frequency variations according to 4.45 can additionally be fed into a recorder and thus used for frequency recording. A suitable Recorder is comprised in the systems BN 444042 and can be added at will to the systems BN 444041.

4.51 Putting into Operation and Application

Instructions for handling the recording mechanism proper (paper change, speed selection, maintenance) will be found in the separate instruction book.

With the mains switch S1 in the lower r.h. corner, the set is made ready for operation. The pilot lamp R11 above S1 will light up. A switching lever behind the door of the recording mechanism serves to switch in the paper feed which is driven by a synchronous motor.

In the systems BN 444042, the rotatable pushbutton S2 on the rear of the Frequency Indicator FKM should be on WITH RECORDER (on the rear). The same holds for systems BN 444041 with a Recorder XMA built in afterwards.

The selector switch permits the movement to be connected at option to the output of the Frequency Indicator FKM—which is connected through the cabinet wiring—or to the input jacks below the switch, for any other recordings. The current required for full deflection is 10 ma, the resistance of the movement about 300 Ω.

A range of indication adapted to the expected variations should be chosen on the Frequency Indicator FKM according to 4.45, for recording. The recording range of the Recorder XMA will then correspond to this range of indication. The front-panel control R54 ALIGNMENT of the Frequency Indicator FKM permits obtaining agreement of the scales. The fastest method of doing this is with full-scale deflection and the switch RANGE OF INDICATION in the position CHECK WITH MAINS FREQUENCY 50 CPS. This alignment will be maintained independent of the range of indication.

4.52 Handling the Paper

The Recorder XMA operates with inkless recording, a stylus burning a trace in metalized paper with the help of an auxiliary voltage (positions RECORDING of selector switch S2). No trace is recorded without auxiliary voltage—positions INDICATION. These latter positions should be used for all adjustments before and during the recording.

Pencils or ink will hardly leave a trace on the metalized paper. If this is desired, the one end of a test lead provided with a probe or banana pin can be used whose other end should be plugged into the jack STYLUS at the lower r.h. corner. Recording tapes which have been taken out of the Recorder XMA have to be connected to this purpose with the jack PAPER through a second line which must make contact with the metal layer, e.g. with the help of alligator clips.

When ordering recording paper please state application "for Recorder Type XMA BN 444511" and time scale.

The development of sparks by the recording process can disturb the reception, if the frequency recording is carried out in conjunction with a receiver (see 4.6). In such cases it may be preferable to resort to the normal ink recording on the usual paper. The Recorder XMA can be adapted to this method by simply changing the paper and recording pen.

4.53 Use of Other Recorders

In the systems BN 444041 which have no built-in recorder any available recorder may be connected to the jacks RECORDER (S4 and S5) of the Frequency Indicator. The current and voltage required for full-scale deflection must not exceed 10 ma and 3 v; the impedance should not be higher than 300 Ω. More sensitive recorders should be shunted.

4.6 Telemetering

The system in conjunction with suitable receivers permits measuring the frequency of distant transmitters. In local measurements, this method caters for an extreme sensitivity with a minimum reaction on the equipment under test. The total sensitivity and the selectivity obtainable merely depend on the characteristics of the receiver used. Above all, unmodulated carriers (A0) can be measured without accessory means, whereas transmitters with modulation A1, A2, A3, F1, and F3 can also be measured by a trained operator.

4.61 Modulation A0, A1, A2, A3, and F1

The receiver is fed, as usual, from an antenna and tuned to the unknown frequency. The output frequency of the Frequency Synthesizer XUA should be coupled to the antenna so loosely that its voltage is of comparable magnitude; now the output should be adjusted to approximately the same (but somewhat lower) value as the unknown frequency by referring to the reading of the receiver (see 4.32). An audible note variable in pitch with the setting of the Frequency Synthesizer will then appear at the output of the receiver. Its frequency exactly corresponds to the difference of the unknown frequency and the one of the Frequency Synthesizer independent of whether one or more frequency conversions take place in the receiver before the rectification (superhet). This frequency can be derived from the connectors for the headphone or second loud-speaker (through coupling capacitors) and measured with the Frequency Indicator; added to the reading of the Frequency Synthesizer it yields the value of the unknown frequency. Registration, as usual, is possible with the Recorder connected.

Tuning to zero beat (not audible) is also possible, if the receiver is provided with a tuning indicator. In the vicinity of

zero beat the latter will show beats which should be made stationary. The circuitry of the tuning indicator and its inertia cater for a very high selectivity in the vicinity of the zero frequency; hence this method can also be employed for the measurement of A3 modulated transmitters.

A similar method can be employed in the audible range with receivers having a second local oscillator for telegraphy reception. The beat note produced by the unknown frequency is to be adjusted to an arbitrary audible frequency and the frequency of the Frequency Synthesizer tuned for the same beat note. The occurring beats show whether the frequencies are equal or not. In this kind of measurement the ear is very selective so that a trained operator is able to measure A3 transmitters or even A1 and A2 modulated transmitters. For F1 modulation the method is the same as for A1 and yields two values whose difference corresponds to the deviation.

Telemetering above 30 mc is carried out in the same manner. Here, however, the reference frequency should be derived from the upper l.h. jack F_X of the Frequency Indicator where the harmonics of the Frequency Synthesizer applied to the center jack F_V are available. Since their voltage is lower, a closer coupling to the antenna may be necessary. The order of the harmonic used can be seen from the calibration of the receiver.

4.62 F3 Modulation

During the intervals between the programs the F3 modulated transmitters do not differ from unmodulated transmitters and can be measured in the same manner. At modulation virtually no fixed carrier frequency is present, but the arithmetic mean of the frequency band covered is defined as "center frequency". To measure the latter, the reference frequency f_v, in accordance

with 4.46, should be reduced in the Frequency Synthesizer XUA by at least the maximum frequency deviation, say, 100 kc for broadcast transmitters. The receiver should be left adjusted for amplitude demodulation. An average difference frequency of 100 kc will appear at its output. This difference frequency varies by the value of the deviation; between 25 kc and 175 kc, for instance, by a 75-kc deviation. It is applied to the Frequency Indicator FKM (range 150 kc) which automatically produces the arithmetic mean. The reading of the FKM should be added to the value set on the Frequency Synthesizer XUA, if one wants to obtain the "center frequency" of the tested transmitter. The calculation will be simpler, if the difference is exactly adjusted to 100 kc by setting the Frequency Synthesizer correspondingly. The accuracy can be further increased by an accurate calibration of the Frequency Indicator FKM for this special frequency, by comparison against the 100 kc standard frequency from the Midget Crystal Clock XSZ (see 5.24). A correspondingly lower difference frequency can be used with transmitters of lesser deviation. The measurement requires a receiver having a sufficient a-f bandwidth; especially suitable is the OUTPUT FOR OSCILLOSCOPE provided on certain sets (e.g. our type ESM).

5 Maintenance

5.1 Maintenance Work

When the system is not operated the FKM, XMA, and XNA should be switched off to spare the tubes. The Midget Crystal Clock XSZ should be permanently switched on, if highest frequency stability is required, and shall be checked with the aid of the built-in synchronous clock.

The Power Supply XNA should not be switched on again before the tubes of the Frequency Synthesizer XUA have cooled down (wait several minutes). Immediate switching on may cause damage.

The cabinet door should be kept closed during operation. When the door closes the blowers are automatically started by a pushbutton. They should be oiled time and again. Certain systems contain blowers with ball bearings which do not require oiling.

The scale drives of the Frequency Synthesizer XUA and the movement of the Recorder XMA should be locked during transit (slide at the inner side of the door of the Recorder).

5.2 Adjustment

The system should be adjusted when put into operation for the first time, after transportation or on other occasions that may possibly disturb the satisfactory operation.

To this end, the units can, generally, be left in the cabinet rack. If the adjusting means to be operated are not accessible from the front, it is necessary to remove the set in question. To do this, slacken off the hexagonal screws at the front panel edges with the help of the wrench (width 10 mm) supplied with the set; then remove the unit from the rack. The multipoint connections between the unit and rack are thereby interrupted. When separated from the rack, the units are fed through extension cables (HT 556/8/2) delivered with the system and serving the connection between the connector strip(s) of the unit and the associated strip(s) of the rack.

With the system switched off, the needles of all meters must be on zero. The slotted screws below the scales serve the correction of the mechanical zero.

The following operations can be carried out, as the case may be:

5.21 Midget Crystal Clock Type XSZ

The setting of the hands has been described under 4.21.

5.211 Operational Check

The meter I1 (not calibrated) and the switch S3 CHECK permit the currents of the corresponding stages to be checked. It is recommended to make this check periodically, e.g. once a week, and to note the results.

The first switch position THERM. serves to check the functioning of the oven. The needle of the meter should deflect alternately to the marked range and again to a small residual value. The first is indicative of the condition "Thermostat ON". At normal ambient temperature the period of this alternating deflection will be about 2 + 2 minutes after a warm-up period of several hours. Considerable variations of this value can be caused by too high or too low ambient temperatures; if this seems not to be the case there is reason to suspect that the switching temperature of the thermometer has changed, e.g. by vibrations. For remedy see 5.31.

In the switch position QUARTZ the plate current of the crystal oscillator tube Rö1 is measured. The needle should be in the marked section. Slight variations may occur during the warm-up period. A steady increase during a longer service time is indicative of an increasing crystal impedance which may go along with the well-known aging process. This is without importance unless the crystal oscillations are stopped by the increased impedance. The latter case may be suspected, if the meter shows full deflection, but it can be made sure only by measuring the 100 kc output voltage of the Midget Crystal Clock.

The other switch positions (100 KC, etc. CLOCK) serve to check the currents of the tubes Rö2, Rö4, Rö6, Rö8, Rö9, and Rö10 +

Rö11. The needle should again be within the marked section. A slow decrease is mostly due to aging of tubes. If the needle deflects to the left or right stop, a complete failure of tubes, a short-circuit or discontinuities in the circuitry must be suspected.

5.212 Frequency Setting

The frequency can be varied and adjusted by means of a fine trimmer C1 FREQ. ADJ. and a coarse trimmer C2. Both trimmers reduce the frequency when turned clockwise. This will effect a slower rate.

The fine trimmer is accessible from the front panel after a cover plate has been turned aside and can be operated with a knob provided with ten scale divisions. One scale division roughly corresponds to a frequency cariation $\Delta f/f$ of 1 part in 10^7. The total range covers five revolutions corresponding to a frequency variation of about 5 parts in 10^6.

In the newer sets (KL 51/...) the coarse trimmer is arranged below the fine trimmer. It is accessible after slackening of a covering screw and can be operated by means of a hexagonal wrench of 6 mm size opening. In the earlier sets(KL 32/..., KL 36/...) the coarse trimmer can only be operated from below after removal of the bottom panel. To this end the Midget Crystal Clock must be removed from the cabinet rack. The coarse trimmer admits of 8 revolutions corresponding to a total frequency variation of 2 to 4.5 parts in 10^5.

5.213 Frequency Checking

The frequency of the Midget Crystal Clock XSZ can be checked by comparison against other frequency standards or wireless standard frequencies, or indirectly, by time comparison. The

locked output frequencies of the Frequency Synthesizer XUA, being immediately controlled by the Midget Crystal Clock XSZ, can also be used for the frequency comparison. With the time of observation unchanged the accuracy will be the better, the higher the frequency. Ordinarily, it is not interesting to know the magnitude of the frequency error; the actual purpose of the comparison is to eliminate the error in a simple and rapid manner.

5.2131 Comparison against Other Frequency Standards

It is recommended to resort to the Frequency Indicator FKM, if a comparison against an available frequency standard of higher stability is to be made. The output frequency of the Frequency Synthesizer XUA should be preset to the standard frequency. In all further respects refer to 4.43. The needle of the meter BEAT of the Frequency Indicator FKM should be brought to a standstill with the help of the trimmer of the Midget Crystal Clock XSZ, but not by varying the setting of the Frequency Synthesizer XUA.

A cathode ray oscilloscope can be used instead of the Frequency Indicator FKM. The ellipse appearing on the screen should also be brought to a standstill by means of the trimmers of the Midget Crystal Clock XSZ.

5.2132 Comparison with Wireless Standard Frequencies

A list of transmitters sending standard frequencies of extreme accuracy is attached in the appendix. The accuracy may be affected by propagation phenomena in case of reception over long distances but will be sufficient in any case for checking the Midget Crystal Clock XSZ. Only the carrier frequency is used for comparison. The modulation is of no importance.

The carrier frequencies of broadcast transmitters are often highly accurate and can also be used as standards.

The comparison measurement requires a receiver. The procedure is set forth in 4.6. The Frequency Synthesizer XUA should be adjusted to the nominal value of the frequency received. For zero beat adjustment turn the trimmers of the Midget Crystal Clock XSZ.

5.2133 Frequency Checking by Time Comparison

The frequency checking by time comparison, formerly the sole method of checking frequency standards, has lost much of its importance and is nowadays used in those cases only where no standards of higher accuracy are available or where the reception of standard frequencies is difficult. This method is more painstaking than the direct frequency comparison and does not yield immediate results. Nevertheless, with an eye to this method the Midget Crystal Clock XSZ has been provided with a built-in synchronous clock having an index plate and seconds contact and fed by the 50-cps frequency derived from the crystal frequency.

A frequency error $\Delta f/f$ of 1 part in 10^5 causes an advance or delay of the clock (rate "r") of 0.864 sec per day. If the clock error (e) is measured periodically against a standard time and the difference of errors Δe is divided by the corresponding time interval Δt, the frequency error is obtained by

$$\Delta f/f = 1.156 \cdot \frac{\Delta e \ (sec)}{\Delta t \ (day)} \cdot 10^{-5}.$$

This result permits making a frequency correction as under 5.212. Some of the standard frequency transmitters listed in the appendix deliver additional time signals.

With small frequency errors it takes some time (possibly several weeks) until the time deviations are so large as to be obvious from the position of the sweep hand. More accurate measurements can be made by means of the seconds contact if special test sets for short time intervals are available.

These can be fully replaced by observing "rhythmic time signals" which consist of a series of 306 signals sent within 300 seconds. The signals 1, 62, 123, 184, and 245 will always begin with the full minute. They represent dashes of about 0.4 sec followed each by 60 dots of 0.1 sec. The interval between the starts of two successive signals is 60/61 = 0.984 sec.

For monitoring the one earpiece of a headset should be series connected to the output jack 1 kc and the seconds contact of the Midget Crystal Clock XSZ. Thus audible pulses spaced 1 sec apart will be obtained. The other earpiece is fed by a receiver serving the reception of the rhythmic signal. The signals being sent with A1 modulation, the receiver should be equipped with a BFO. The headphone permits monitoring both types of signals simultaneously. The two pulse trains continuously shift against each other. Once a minute two signals will coincide.

The measurement should be carried out as follows:

(a) the time of the pulse immediately preceding a dash of the rhythmic signal should be accurately read on the dial of the Midget Crystal Clock XSZ at the full second;

(b) also read the time of the subsequent coincidence of the time signal with the rhythmic signal;

(c) the difference in seconds of the times read according to (a) and (b) yields the "Interval No." listed in the annexed table where the necessary correction to the value (a) can be found. The error e of the Midget Crystal Clock results as the difference between the corrected value (a) and the nominal time of the dash signal used.

Examples:

Reading under (a) . . . . . 12 hr 00 min 56 sec
Reading under (b) . . . . . 12 hr 01 min 27 sec
Difference (b) − (a) = Interval No. . 31 sec
Correction according to table . . . . 0.508 sec
Corrected value (a) . . . . . 12 hr 00 min 56.51 sec
Nominal value of line signal . . . . 12 hr 01 min 00 sec
Error e . . . . . 3.49 sec (clock is slow)

For better accuracy the measurement may be repeated five times during the whole duration of the time signal in order to obtain a mean value. If, for example, the clock error is 3.21 sec (behind) after 30 days, the clock is fast. The frequency error is

$$\Delta f/f = + 1.156 \cdot \frac{0.28}{30} \cdot 10^{-5} = + 1.08 \cdot 10^{-7}$$

The fine trimmer, in this case, should be turned clockwise by one division.

5.22 Frequency Synthesizer Type XUA

The small knobs below the scales are respectively connected with the circuit elements C369 (CALIBRATION A), C393(CALIBRATION B), and L171 (CALIBRATION C) and serve the adjustment of the scales. In some sets CALIBRATION C is still connected with C417; in the newer sets of this type, this capacitor is accessible through a door in the bottom plate and can be operated with an insulated 6-mm wrench. The adjustment should be carried out in the following manner:

5.221 Zero Adjustment of Scales A and B

Throw selector switch to the fourth position from the left. Thus the scales A and B are locked, scale C is ineffective. Adjust

scales A and B to the division 0.0. Tune deflections of the meters I1 and I2 to a maximum by means of the knobs CALIBRATION A and CALIBRATION B, respectively. When adjusted accurately, the set is tuned to the frequency 0; the meter I3 reads no output voltage.

If the reading of I3 does not become zero, the adjustment of CALIBRATION A or CALIBRATION B is not correct so that harmonics of 100 kc or 1 kc will appear. Their value can be read on the Frequency Indicator FKM (see 4.42; the output signal of the Frequency Synthesizer XUA should be applied as reference frequency to the Frequency Indicator FKM). Multiples of 100 kc and 1 kc can be reduced to zero by varying the CALIBRATION A or CALIBRATION B, respectively, while observing the maximum deflection on I1 and I2.

5.222 Calibration of Scale A

Adjust as under 5.221. Slowly turn scale A. At each scale division the meter I1 should show maximum deflection. If there is a slowly increasing deviation from this requirement, CALIBRATION A should be adjusted once again very carefully near the end of the scale; check again at zero as under 5.221.

5.223 Calibration of Scale B

The check can be made in accordance with 5.222. A faster method, however, is the following: A 100-kc frequency derived from the Midget Crystal Clock XSZ is additionally fed as f_x into the Frequency Indicator FKM. Setting of scale B to 99 kc or 101 kc must yield a difference frequency of 1 kc, setting to 98 kc or 102 kc a difference frequency of 2 kc, etc. Again the maximum deflections of I2 should appear with the scale B set exactly to the divisions. Fine correction with CALIBRATION B and check at zero as under 5.221.

5.224 Zero Adjustment and Calibration of Scale C

Throw selector switch to the third position from the left. Lock scale A to 0.0 mc, scale B to 100 kc. Set scale C to the division 0 cps. Connect the Frequency Indicator as under 5.223. Now the Frequency Synthesizer XUA should deliver 100 kc exactly; errors are indicated by beats on the r.h. meter of the Frequency Indicator FKM. Adjust by varying CALIBRATION C. Then lock scale B on 99 kc. Set scale C to 1000 cps. Adjust again with CALIBRATION C, several times alternately with an adjustment at 100 kc/ 0 cps, if necessary.

If the adjustment with CALIBRATION C is not sufficient remove the set from the cabinet rack (see 5.2) and additionally use the capacitor C417 (see 5.22).

5.225 Meters

The meters I1 and I2 have been factory-adjusted by means of the resistors R434 (or R435) and R433 so that tuning to maximum will yield a deflection of about 80 divisions. The meter I3 is adjusted for correct indication of the output open-circuit voltage by means of R418.

A further correction is generally unnecessary. Too high or too low deflections are indicative of improper mains voltage or failures in other parts of the set.

5.23 Power Supply Type XNA for Frequency Synthesizer Type XUA

The Power Supply XNA furnishes the operating voltage for the Frequency Synthesizer XUA. The built-in meter I1 in conjunction with the switch S2 VOLTAGE CHECK serves to check the mains voltage (blue scale) and the output voltages (d-c plate voltages black scale, a-c filament voltages green scale). The nominal values are indicated by red marks.

The mains voltage should not fluctuate by more than ± 10 % of the nominal value; otherwise a satisfactory operation of the Power Supply XNA and Frequency Synthesizer XUA cannot be guaranteed. Besides other troubles an overvoltage would cause overloading, at least in permanent operation, whereas undervoltage would make the output voltage of the Frequency Synthesizer XUA drop considerably. In case of the power-lines with considerable deviations of the average voltage level it is advisable to use an adapter transformer; with severe mains voltage fluctuations it is recommended to use an additional automatic voltage stabilizer, e.g. our Power Supply for Constant AC Voltage Type NWK BN 95132.

Even with mains voltage fluctuations, the d-c plate voltages are kept at the ratings of 180 v or 250 v, respectively, by the stabilizing circuitry in the Power Supply XNA. Deviations will occur only with failures in the set—especially with defective tubes—or if the mains voltage is so low that the stabilizers Rö5 and Rö10 do not fire.

After replacement of tubes, in particular of the stabilizers, the d-c plate voltages can be adjusted to their ratings by means of the resistors R15 and R30.

As a considerable voltage drop occurs between the Power Supply XNA and the Frequency Synthesizer XUA, the meter I1 should read about 7 v instead of 6.3 v during the measurement of the filament voltages. The fluctuations of indication are directly proportional to the mains voltage.

5.24 Frequency Indicator Type FKM

After switching on, the zero of the r.h. meter I2 BEAT may vary. The knob EL. 0 (R120) above the meter serves the correction. The scale itself is not calibrated and need not be adjusted.

Nine controls are provided for the correction of the scale calibration of the l.h. meter I1 FREQUENCY: the control R55 CALIBRATION below the meter and the controls R57 thru R65 which are labeled with the associated measuring ranges and mounted at the r.h. side wall. The latter are accessible only with the set removed from the cabinet rack. The calibration should begin with the frequency range switch S1 on CALIBRATION WITH MAINS FREQUENCY 50 CPS and will then refer to the mains frequency; however, a better method is to put the switch to 50 CPS and thus to use the output frequency 50 cps of the Midget Crystal Clock XSZ. This latter frequency should be fed to the input jack F_X 10 CPS TO 500 KC at the lower l.h. corner through one of the coaxial cables supplied with the set. In both cases the exact full-scale deflection of 50 should be obtained by means of the control CALIBRATION. For the other measuring ranges accurate calibration frequencies are derived either from the Midget Crystal Clock XSZ (100 cps, 1 kc, 10 kc, 100 kc) or from the Frequency Synthesizer XUA (about 1 v at 5 kc, 15 kc, 50 kc, 150 kc, 300 kc, each with the scales A and B locked and scale C switched off). In this case, the needle deflection should be adjusted to the correct value by means of the associated controls R57 thru R65, with the position of the control CALIBRATION unchanged. For later corrections the adjustment at 50 cps will generally be sufficient. The control ADJUSTMENT R54 just serves to set the deflection on the Recorder XMA (see 4.51) and does not influence the calibration of the Frequency Indicator FKM as long as the impedance of the recorder connected is less than 300 ohms.

5.25 Recorder Type XMA

The adjustment of the recording mechanism is described in the separate operating instructions supplied with the set. The adjustment of the deflection has been described under 4.51.

5.26 Cabinet Rack Type NG 4

The number of revolutions of the blowers will vary after a longer service time. It can be adjusted by suitably tapping the associated transformer and should ensure that the blowers will dependably start without causing a noticeable vibration of the door or the cabinet rack.

5.3 Trouble Shooting and Repairs

The location of faults is facilitated by self-contained checking devices as well as the neat arrangement and the above circuit theory. The attached circuit diagrams and tables of replaceable parts will also be helpful in this respect. Each element listed is labeled in the equipment itself and thus easily found.

Smaller repair work can be carried out by the customer himself if he has trained personnel. All frequency determining parts, especially the filters, should be handled very carefully. Tubes should be replaced only by the same types. For critical tubes see below. Capacitors, resistors, and rectifiers, can be replaced by items of other origin if these have the same electrical characteristics and tolerances as the original ones. If suitable spares are not available please write to this company. All coils, transformers, and meters should be bought from us. Please consult with us in case of doubt. For greater repair work it will mostly be necessary to turn the system or the unit in question in to our factory or to ask for the visit of a specialist. Some special sources of faults and the suitable remedies are set forth in the following.

5.31 Midget Crystal Clock Type XSZ

All tubes can be replaced by items of the same type without special selection.

Switching times of the oven which differ considerably from the values given under 5.211 may be due to a poor seat of the thermometer sleeve in the guide tubing, caused e.g. by transport. The sleeve should be inserted as far as it will go. It is accessible with the lid of the oven casing removed (turn to the left). Besides, the mercury column of the thermometer may be interrupted. This can be seen through the slots in the sleeve when the latter has been pulled out. When carefully warmed up, the mercury flows together in the upper enlarged part of the capillary tube and withdraws as a coherent thread after having cooled down again. A line tester permits checking the contact of the thermometer within the sleeve. The sleeve can be disassembled for re-establishing a satisfactory contact. If checking the thermometer requires a longer period of time, the unit must be switched off in order to avoid overheating. When re-inserted in an overheated oven the thermometer may be damaged again.

The crystal provided with a plug-in mount is probably defective if at 100 kc the unit does not deliver an output voltage. With the oven opened—all lids can be removed by turning them counterclockwise—the crystal is accessible. Broken wires of the crystal holder, for instance, will always stop the oscillations whereas crystals with broken glass bulbs often will continue to oscillate, but at a great frequency error. In both cases it is necessary to order a new crystal. Please state then the serial number of the unit.

The frequency division is achieved by synchronized, self-oscillating stages, and the subharmonics, although with erroneous values, are hence present even in case of a failure of the crystal oscillation. Errors in frequency dividing are clearly obvious from considerable errors in time indication. The defective stage is easily found by an oscilloscopic comparison of two subsequent frequencies. No stationary Lissajous figure will be

obtained in case of disturbances. Errors in frequency division are mostly due to defective tubes if no other defective circuit elements can be found. Detuning of the circuits will occur rarely; as far as it is caused by the coils only, careful tuning is possible by means of the cores.

5.32 Frequency Synthesizer Type XUA

Most of the tubes can be replaced without being especially selected. Exceptions are to be made for Rö34 (EF 800) and Rö202 (EC 81). The conversion transconductance of the Type EF 800 varies considerably. A low conversion transconductance will involve a lower output voltage. The item that yields the highest output voltage should therefore be selected from among the spare tubes. A replacement of Rö202 may cause the range of scale A to be shifted. The readjustment can be made with the help of the coil L153, control TUNING A, and possibly the section of the capacitor C369 that is not connected with the latter. Refer to 5.221 and 5.222.

If the rated values of the output voltage or the other meter deflections cannot be obtained this might be due to detuning of the filters. Proceed carefully, when correcting for this, to avoid detuning of the whole set. The frequencies present at the different points of the set can be seen from the drawing 444461 A Bl. II. The alignment will be made by applying these frequencies from an external signal generator. To this end suitable feeding points (jacks Sh 1 thru 4, Sh 11 thru 13) have been provided which lend themselves to level measurements, also. The following voltages should be obtainable in a measurement with the probe of our Electronic Multimeter URI (without compensation of the detuning due to the probe): 0.24 v across jack Sh 1, 0.5 to 0.8 v across Sh 3, 0.8 v across Sh 12. Using

the d-c probe of the URI one should measure about 3.5 v across Sh 4, 8 to 14 v across Sh 11. In dusty or damp rooms the scale drives may fail. In this case carefully clean the guide rods of the slide carrying the plexiglass pointer and apply a film of high-quality grease.

All repair work on the Frequency Synthesizer XUA is facilitated by its mounting on two independent steel frames which are held together by four screws and connected electrically by detachable, flexible cables. After loosening of the four screws the rear frame can be swiveled round its upper inner edge and leaned against the front frame. All parts of the set are then easily accessible without interruption of the wiring. The set can be readily operated in this condition.

5.33 Power Supply Type XNA

The tubes can be replaced without being specifically selected. If the stabilizers Rö5 or Rö10 are replaced the output voltages should be readjusted as set forth under 5.23.

5.34 Frequency Indicator Type FKM

The tubes can be replaced without being specifically selected. If the stabilizer Rö20 is replaced a new frequency calibration is necessary according to 5.24.

Correction Table for Rhythmic Signals

Interval No.	0	1	2	3	4	5	6	7	8	9
0	000	016	033	049	066	082	098	115	131	148
1	164	180	197	213	229	246	262	279	295	311
2	328	344	361	377	393	410	426	443	459	475
3	492	508	525	541	557	574	590	607	623	639
4	656	672	688	705	721	738	754	770	787	803
5	820	836	853	869	885	902	918	934	951	967
6	984	Corrections in milliseconds								

Rot

Standard-frequency and time-signal stations	England I

Station . . . . . Rugby, England (British Post Office)

Call-sign . . . . . MSF

Responsible for accuracy . . . . . National Physical Laboratory, Teddington Middx., England

Standard frequencies used . . . . carrier and modulation

Frequency accuracy . . . . . better than 2 parts in 10^8

Oscillator drift . . . . . less than 0.5 parts in 10^8/month

Limits for frequency correction . . less than 2 parts in 10^8

Time signals . . . . . seconds pulses, consisting of five cycles of the frequency 1000 cps ("1 cps")

Accuracy of time intervals . . . . better than 2 parts in 10^8 ± 1 µsec

Time corrections . . . . . in steps of 50 or 100 msec (the 1st day of each month only)

Details

Carrier frequency Kc	Power Kw	Transmission times Universal time (GMT)
2,500	0.5	permanently, with interruptions from minute 15 to minute 20 of each hour
5,000	0.5	
10,000	0.5	
60	10	daily from 14.29 to 15.30 hrs

Modulation schedule

Minute				Modulation frequency
0 to 5		30 to 35	45 to 50	1000 cps
5 to 10	20 to 25	35 to 40	50 to 55	1 cps, second 59 suppressed
10 to 14	25 to 29	40 to 44	55 to 59	unmodulated
14 to 15	29 to 30	44 to 45	59 to 60	announcement

References . . . . . U.K. National Physical Laboratory Leaflet: MSF, New Program of Experimental Standard Frequency Transmission from the U.K., May 1953

CCIR London No. 304 and Recommendation No. 122

Wireless Engineer XXIX, No. 342, March 1952, p. 82; id. XXX, No. 6, June 1953 p. 160

Corrections . . . . . periodically published in Wireless Engineer for the preceding month

State of August 1954

Standard-frequency and time-signal stations	England II

Station	Droitwich, England
Announcement	BBC Light Programme
Managing corporation	British Broadcasting Corporation, Broadcasting House, Portland Place, London W1, England
Standard frequency used	carrier 200 kc (400 kw)
Time of transmission	on workdays 9.00 to 24.00 hrs on Sundays 8.00 to 24.00 hrs
Accuracy	better than 1 part in 10^7
References	Rundfunk-Fernseh-Jahrbuch 1954, Kulturbuchverlag Berlin-Kopenhagen-Basel, p. 116 "Grossbritannien" Wireless Engineer XXIX, No. 342, March 1952, p. 82
Corrections	periodically published in Wireless Engineer for the preceding month

State of August 1954

Standard-frequency and time-signal stations	North America

Station . . . . . Beltsville Md., USA

Call-sign . . . . . WWV

Responsible for accuracy . . . . . National Bureau of Standards, Washington D.C., USA

Standard frequencies used . . . . carrier and modulation

Frequency accuracy . . . . . better than 2 parts in 10^8

Oscillator drift . . . . . less than 1 part in 10^8/month

Limits for frequency correction . . less than 1 part in 10^8

Time signals . . . . . seconds pulses, consisting of five cycles of the frequency 1000 cps ("1 cps")

Accuracy of time intervals . . . . better than 2 parts in 10^8 ± 1 µsec

Time corrections . . . . . by changing the frequency (no phase adjustment on the time signals)

Details

Carrier frequency Mc	Power Kw	Transmission times Universal time (GMT)
2.5	10	nonintermittently
5.0	10	
10.0	10 temporarily	
15.0	10 reduced	
20.0	10	
25.0	10	

Rot

Modulation schedule

Minute			Modulation frequency
permanently			1 cps, second 59 suppressed
00 to 04	10 to 14	20 to 24	600 cps
30 to 34	40 to 44	50 to 55	
05 to 09	15 to 19	25 to 29	440 cps
35 to 39	45 to 49	55 to 59	
04 to 05	09 to 10	14 to 15	announcement (universal time, GMT)
19 to 20	24 to 25	29 to 30	
34 to 35	39 to 40	44 to 45	
49 to 50	54 to 55	59 to 60	

References . . . . . LC 1009 USA Bureau of Standards (April 15, 1952)

CCIR London 1953, Recommendation No. 122

State of August 1954

Standard-frequency and time-signal stations	Pacific Ocean

Station . . . . . Maui, Hawai, USA

Call-sign . . . . . WWVH

Responsible for accuracy . . . . . National Bureau of Standards, Washington D.C., USA.

Standard frequencies used . . . . carrier and modulation

Frequency accuracy . . . . . better than 2 parts in 10^8

Oscillator drift . . . . . less than 1 part in 10^8/month

Limits for frequency correction . less than 1 part in 10^8

Time signals . . . . . seconds pulses, consisting of five cycles of the frequency 1000 cps ("1 cps")

Accuracy of time intervals . . . . better than 2 parts in 10^8 ± 1 µsec

Time corrections . . . . . by changing the frequency (no phase adjustment on the time signals)

Details

Carrier frequency Mc	Power Kw	Transmission times Universal time (GMT)
5.0	2	permanently, with interruptions from minute 00 to minute 04 and minute 30 to minute 34 of each hour
10.0	2 tempo-rarily reduced	
15.0	2	

Modulation schedule

Minute			Modulation frequency
permanently			1 cps, second 59 suppressed
	10 to 14	20 to 24	600 cps
	40 to 44	50 to 55	
05 to 09	15 to 19	25 to 29	440 cps
35 to 39	45 to 49	55 to 59	
04 to 05	09 to 10	14 to 15	
19 to 20	24 to 25	29 to 30	announcement (universal time)
34 to 35	39 to 40	44 to 45	
49 to 50	54 to 55	59 to 60	

References . . . . . LC 1009 USA Bureau of Standards (April 15, 1952)

CCIR London 1953, Recommendation No. 122

State of August 1954

Standard-frequency and time-signal stations	Italy

Station . . . . . Turin, Italy

Call-sign . . . . . IBF

Responsible for accuracy . . . . . Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin, Italy

Standard frequencies used . . . . carrier and modulation

Frequency accuracy . . . . . better than 2 parts in 10^8

Oscillator drift . . . . . less than 4 parts in 10^8/month

Limits for frequency correction . . less than 2 parts in 10^8

Time signals . . . . . seconds pulses, consisting of five cycles of the frequency 1000 cps ("1 cps")

Accuracy of time intervals . . . . better than 2 parts in 10^8 ± 1 μsec

Time corrections . . . . . by changing the frequency (no phase adjustment on the time signals)

Details

Carrier frequency Kc	Power Kw	Transmission times Universal time (GMT)
5,000	0.3	daily from 7.00 to 7.30 hrs and from 11.00 to 11.30 hrs

Modulation schedule

Minute			Modulation frequency
05 to 10	25 to 30	45 to 50	440 cps
15 to 20	35 to 40	55 to 60	1000 cps
01 to 05	09 to 15	21 to 25	1 cps, second 0 extended
31 to 35	41 to 45	51 to 55	
00 to 01	10 to 11	20 to 21	announcement (Morse)
30 to 31	40 to 41	50 to 51	

Reference . . . . . C. Egidi: Emissione di segnali orari e di frequenze campioni dall'IEN di Torino. Alta Frequenza XX (1951), p. 219 to 223

Corrections . . . . . periodically published in Alta Frequenza and Elettronica

State of January 1955

Standard-frequency and time-signal stations	South Africa

Station . . . . . Johannesburg, Union of South Africa

Call-sign . . . . . ZUO

Responsible for accuracy . . . . . Observatory of the Union of South Africa

Standard frequencies used . . . . carrier

Frequency accuracy . . . . . better than 2 parts in 10^8 (referred to WWV)

Oscillator drift . . . . . less than 1 part in 10^8/month

Limits for frequency correction . . less than 2 parts in 10^8

Time signals . . . . . seconds pulses, consisting of 100 cycles of the frequency 1000 cps ("1 cps")

Accuracy of time intervals . . . . better than 2 parts in 10^8 ± 10 µsec

Time corrections . . . . . by changing the frequency (no phase adjustment on the time signals)

Details

Carrier frequency Mc	Power Kw	Transmission times Universal time (GMT)
5.0	0.1	nonintermittently

Modulation schedule

Minute	Modulation frequency
permanently	1 cps

State of August 1954

Wichtige

Normalfrequenz- und Zeitsignal-Stationen

ROHDE & SCHWARZ

Normalfrequenz- und Zeitsignal-Stationen	Groß-Britannien II

Station	Droitwich, England
Ansage	BBC Light Program
Betriebsgesellschaft	British Broadcasting Corporation, Broadcasting House, Portland Place, London W 1, England
Normalfrequenz	Träger 200 kHz (400 kW)
Sendezeit	Werktags 9.00...24.00 Uhr (GMT Sonntags 8.00...24.00 Uhr (GMT
Frequenzfehler	$< \pm 1 \cdot 10^{-7}$
Veröffentlichungen	Rundfunk Fernseh Jahrbuch 1955 "Großbritannien" Seite 122 Kulturbuch-Verlag Berlin - Kopenhagen - Basel World Radio Handbook for Listeners "Great Britain" p. 52 Published by O. Lund Johansen Kopenhagen Standard-Frequency Transmissio (Communication from the Nation Physical Laboratory) Wireless Engineer, Vol. XXIX, No. 342, p. 82; March 1952 Standard-Frequency Transmissio Droitwich 200 kc/s Letter to the Editor Wireless Engineer, Vol. 33, No. 12, p. 301; December 1956
Korrekturen	bis August 1956 im Wireless Engineer

Stand Januar 1957

ROHDE & SCHWARZ

Normalfrequenz- und Zeitsignal-Stationen	Vereinigte Staaten von Nordamerika

ion	Beltsville Md., USA
eichen	WWV
ntwortlich für Genauigkeit . . .	National Bureau of Standards, Washington D.C., USA Informationen durch: National Bureau of Standards Boulder Laboratories - Boulder, Colorado
alfrequenzen	Träger und Modulation
uenzfehler	$< \pm 1 \cdot 10^{-8}$
ankungen der Frequenz	$< \pm 1 \cdot 10^{-9}$
lere tägliche Frequenzänderung .	$< \pm 2 \cdot 10^{-10}$
uenzkorrekturen	wenn notwendig täglich um 19.00 Uhr (GMT, UT)
signale	Sekundenimpulse, bestehend aus fünf Schwingungszügen der Frequenz 1000 Hz ("1 Hz")
er beliebiger Zeitintervalle . .	$< 1 \cdot 10^{-8} \pm 1\ \mu s$
korrekturen	wenn notwendig exakt ± 20 ms am Mittwoch 19.00 Uhr Weltzeit (GMT, UT)

elheiten

Trägerfrequenz MHz	Leistung kW	Sendezeiten Weltzeit (GMT, UT)
2,5 5,0 10,0 15,0 20,0 25,0	0,7 8,0 9,0 9,0 1,0 0,1	Ständig mit Unterbrechungen von Minute 45 bis Minute 49 jeder Stunde

ROHDE & SCHWARZ

Modulationsschema

Minute			Modulationsfrequenz
ständig			1 Hz, Sekunde 59 unterdrückt
00...03 30...33	10...13 40...43	20...23 50...53	600 Hz
05...08 35...38	15...18	25...28 55...58	440 Hz
04...05 19...20 34...35 49...50	09...10 24...25 39...40 54...55	14...15 29...30 44...45 59...60	Ansage (Weltzeit, GMT)
19,5	49,5		Ausbreitungsbedingungen

Veröffentlichungen . . . . . U.S. Dept. of Commerce
National Bureau of Standards
Letter Circular LC 1009

CCIR London 1953, Empfehlung
Nr. 122

Reference Data for Radio
Engineers, Fourth Edition.
"Standard Frequencies and
Time Signals" p. 25
International Telephone and
Telegraph Corporation
New York 4, New York

Transmission Program for
WWV and WWVH
Electronics, Vol. 29, No. 9,
p. 194;
September 1956

Standard Frequencies and
Time Signals WWV and WWVH
Proceedings of the IRE,
Vol. 44, No. 10, p. 1470;
October 1956

ROHDE & SCHWARZ

Normalfrequenz- und Zeitsignal-Stationen	Hawaii-Inseln

ion	Maui, Hawaii, USA
eichen	WWVH
ntwortlich für Genauigkeit	National Bureau of Standards, Washington D.C., USA Informationen durch: National Bureau of Standards Boulder Laboratories - Boulder, Colorado
alfrequenzen	Träger und Modulation
uenzfehler	$< \pm 1 \cdot 10^{-8}$
wankungen der Frequenz	$< \pm 3 \cdot 10^{-9}$
lere tägliche Frequenzänderung . .	$< \pm 4 \cdot 10^{-10}$
uenzkorrekturen	wenn notwendig täglich in der Pause von 19.00 bis 19.34 Uhr (GMT, UT)
tsignale	Sekundenimpulse bestehend aus sechs Schwingungszügen der Frequenz 1200 Hz ("1 Hz")
er beliebiger Zeitintervalle . . .	$< \pm 1 \cdot 10^{-8} \pm 1$ µs
tkorrekturen	wenn notwendig täglich in der Pause von 19.00 bis 19.34 Uhr gegen WWV auf 500 µs genau

zeiten

Trägerfrequenz MHz	Leistung kW	Sendezeiten Weltzeit (GMT, UT)
5,0 10,0 15,0	2 2 2	Ständig mit Unterbrechungen von Minute 00 bis Minute 04 und Minute 30 bis Minute 34 jeder Stunde und 19.00 bis 19.34 Uhr jeden Tages

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Modulationsschema

Minute			Modulationsfrequenz
ständig			1 Hz, Sekunde 59 unterdrückt
	10...13 40...43	20...23 50...53	600 Hz
05...08 35...38	15...18 45...48	25...28 55...58	440 Hz
04...05 19...20 34...35 49...50	09...10 24...25 39...40 54...55	14...15 29...30 44...45 59...60	Ansage (Weltzeit, GMT)
9,4	39,4		Ausbreitungsbedingungen

Veröffentlichungen . . . . . U.S. Dept. of Commerce
National Bureau of Standards
Letter Circular LC 1009

CCIR London 1953, Empfehlung
Nr. 122

Reference Data for Radio
Engineers, Fourth Edition.
"Standard Frequencies and
Time Signals" p. 25
International Telephone and
Telegraph Corporation
New York 4, New York

Transmission Program for
WWV and WWVH
Electronics, Vol. 29, No. 9,
p. 194;
September 1956

Standard Frequencies and
Time Signals WWV and WWVH
Proceedings of the IRE,
Vol. 44, No. 10, p. 1470;
October 1956

Stand Januar 1957

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ormalfrequenz- und eitsignal-Stationen	Italien

on	Turin, Italien
ichen	IBF
twortlich für Genauigkeit	Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin, Italien
lfrequenzen	Träger und Modulation
enzfehler	$< \pm 2 \cdot 10^{-8}$
ge Frequenzänderung	$< \pm 4 \cdot 10^{-8}$/Monat
enzkorrekturen	$< 2 \cdot 10^{-8}$
signale	Sekundenimpulse, bestehend aus fünf Schwingungszügen der Frequenz 1000 Hz ("1 Hz")
r beliebiger Zeitintervalle . . .	$< \pm 2 \cdot 10^{-8} \pm 1$ µs
korrekturen	durch Frequenzänderung (keine Phaseneinstellung der Zeitsignale)

elheiten

rägerfrequenz kHz	Leistung kW	Sendezeiten Weltzeit (GMT, UT)
5 000	0,3	täglich 7.00...7.30 Uhr und 11.00...11.30 Uhr

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7 · TELEPH. 442821 · TELEGR. ROHDESCHWARZ

Modulationsschema

Minute			Modulationsfrequenz
05...10	25...30	45...50	440 Hz
15...20	35...40	55...60	1000 Hz
01...05 31...35	09...15 41...45	21...25 51...55	1 Hz, Sekunde 0 verlängert
00...01 30...31	10...11 40...41	20...21 50...51	Ansage (Morse)

Veröffentlichungen . . . . . C. Egidi: Emissione di signali orari e di frequenze campioni dall'IEN di Torino. Alta Frequenza XX (1951), S. 219...223

Korrekturen . . . . . Laufende Veröffentlichungen in Alta Frequenza und Elettronica

Stand Januar 1955

ROHDE & SCHWARZ

Normalfrequenz- und Zeitsignal-Stationen	Südafrikanische Union

ion	Johannesburg, Südafrika
eichen	ZUO
ntwortlich für Genauigkeit	Observatorium der Südafrikanischen Union
alfrequenzen	Träger
uenzfehler	$< \pm 2 \cdot 10^{-8}$ (gegenüber WWV)
ige Frequenzänderung	$< +1 \cdot 10^{-8}$/Monat
uenzkorrekturen	$< 2 \cdot 10^{-8}$
signale	Sekundenimpulse, bestehend aus 100 Schwingungszügen der Frequenz 1000 Hz ("1 Hz")
er beliebiger Zeitintervalle . . .	$< \pm 2 \cdot 10^{-8} \pm 10$ µs
korrekturen	durch Frequenzänderung (keine Phaseneinstellung der Zeitsignale)

elheiten

rägerfrequenz MHz	Leistung kW	Sendezeiten Weltzeit (GMT, UT)
5,0	0,1	ununterbrochen

lationsschema

inute	Modulationsfrequenz
tändig	1 Hz

Stand August 1954

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Notizen:

ROHDE & SCHWARZ

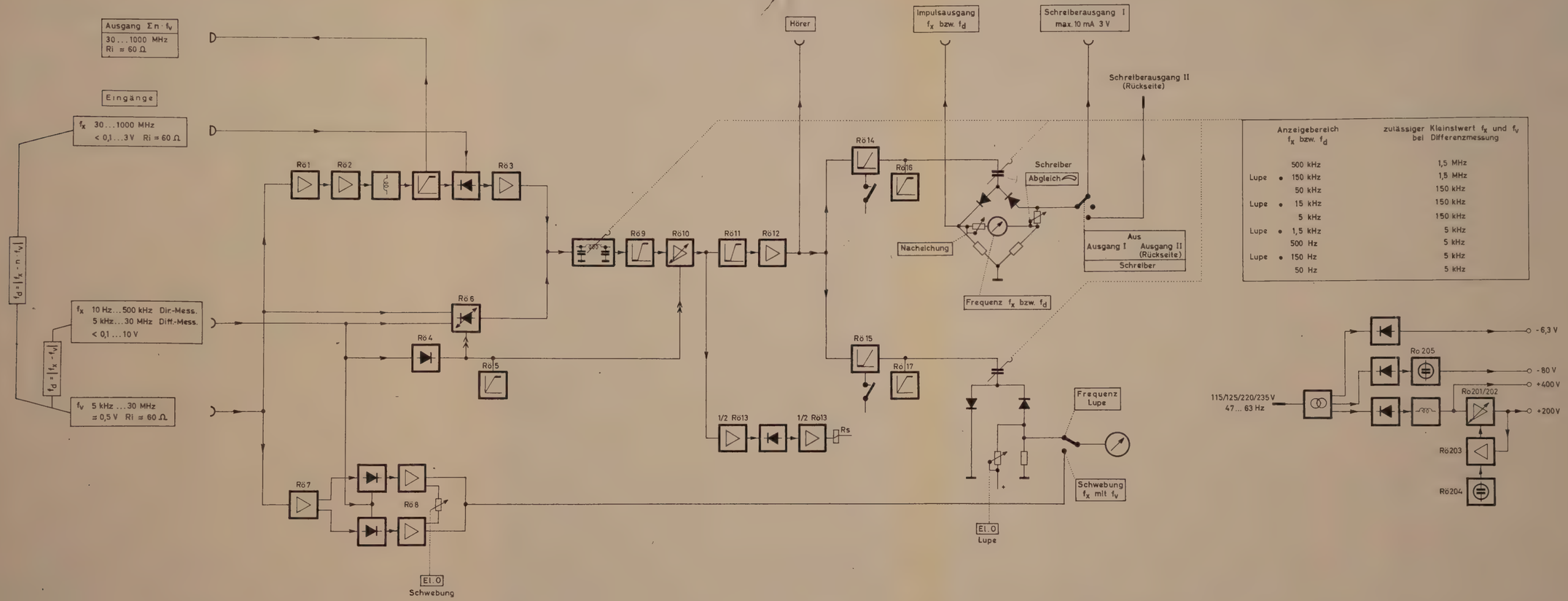
Ausgabe Juli 1957

ROHDE & SCHWARZ · MÜNCHEN 9 · [illegible]

Accessories

for the Decade Frequency Measuring System Type XZA BN 444043

1	Instruction book for the Decade Frequency Measuring System Type XZA (R 5133 e)	
1	Power cord	LK 333
2	16-conductor cable	HT 756/108/2
1	RF cable	R 6455/75
1	RF cable	R 6455/200
1	13-mm connector	FS 413/12
1	Dezifix B connector	FS 432
1	Alignment tool 6 mm	CZ 906



Anzeigebereich f_x bzw. f_d		zulässiger Kleinstwert f_x und f_v bei Differenzmessung
500 kHz		1,5 MHz
Lupe • 150 kHz		1,5 MHz
50 kHz		150 kHz
Lupe • 15 kHz		150 kHz
5 kHz		150 kHz
Lupe • 1,5 kHz		5 kHz
500 Hz		5 kHz
Lupe • 150 Hz		5 kHz
50 Hz		5 kHz

R 5899 Bl.1

Gültig für Komm. 1139, 1180, 1249

Stromlauf zu: Frequenzzeiger Type FKM BN 47051

Zeichn. Nr. 47 051 A

able of Replaceable Parts for Frequency Indicator Type FKM BN 47051

(Gültig für Komm. 1180, 1249)

ef. o.	Designation	Ratings	R&S Stock No.
1	Capacitor, synth. foil	100 µµf/500 v	CKD 2/100/500
2	Capacitor, ceramic	2200 µµf	CCG 94/2200
3	Capacitor, ceramic	2200 µµf	CCG 94/2200
4	Capacitor, ceramic	2200 µµf	CCG 94/2200
5	Capacitor, synth. foil	100 µµf/500 v	CKD 2/100/500
6	Capacitor, ceramic	2200 µµf	CCG 94/2200
7	Capacitor, ceramic	2200 µµf	CCG 94/2200
8	Capacitor, ceramic	10 µµf	CCG 41/10
11	Capacitor, ceramic	100 µµf	CCH 31/100
12	Capacitor, ceramic	1000 µµf	CCG 94/1000
13	Capacitor, ceramic	4 µµf	CCG 41/4
14	Capacitor, ceramic	1000 µµf	CCG 94/1000
15	Capacitor, ceramic	10 µµf	CCG 41/10
16	Capacitor, paper	25,000 µµf/250 v	CPK 25 000/250
17	Capacitor, ceramic	2200 µµf	CCG 94/2200
18	Capacitor, MP	1 µf/250 v	CMR 1/250
21	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
22	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
23	Capacitor, MP	1 µf/250 v	CMR 1/250/2
24	Capacitor, MP	0.5 µf/250 v	CMP 0,5/250/2
25	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
26	Capacitor, paper	25,000 µµf/250 v	CPK 25 000/250
27	Capacitor, MP	8 µf/250 v	CMR 8/250
28	Capacitor, electrolytic	100 µf/15 v	CED 21/100/15

f. .	Designation	Ratings	R&S Stock No.
1	Capacitor, paper	25,000 µµf/250 v	CPK 25 000/250
2	Capacitor, ceramic	8 µµf	CCG 41/8
3	Capacitor, MP	4 µf/350 v	CMR 4/350
4	Capacitor, ceramic	2200 µµf	CCG 94/2200
5	Capacitor, paper	10,000 µµf/250 v	CPK 10 000/250
6	Capacitor, paper	10,000 µµf/250 v	CPK 10 000/250
7	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
8	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
1	Capacitor, MP	8 µf/250 v	CMR 8/250
2	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
3	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
4	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
5	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
9	Capacitor, synth. foil	2x8000 µµf ±2%/250 v	2 x CKS 8000/2/250 parallel
0	Capacitor, synth. foil	2x8000 µµf ±2%/250 v	2 x CKS 8000/2/250 parallel
1	Capacitor, synth. foil	2x8000 µµf ±2%/250 v	2 x CKS 8000/2/250 parallel
2	Capacitor, synth. foil	8000 µµf ±2%/250 v	CKS 8000/2/250
3	Capacitor, synth. foil	470 µµf ±2%/1000 v	CKS 470/2/1000
4	Capacitor, synth. foil	500 µµf ±2%/500 v	CKS 500/2/500
5	Capacitor, synth. foil	500 µµf ±2%/500 v	CKS 500/2/500
6	Capacitor, synth. foil	230 µµf ±2%/1000 v	CKS 230/2/1000
7	Capacitor, ceramic	22 µµf	CCH 31/22
8	Capacitor, ceramic	47 µµf	CCH 31/47
9	Capacitor, ceramic	47 µµf	CCH 31/47

f. .	Designation	Ratings	R&S Stock No.
50	Capacitor, ceramic	8 µµf	CCG 41/8
53	Capacitor, synth. foil	2500 µµf/500 v	CKS 2500/500
54	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
65	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
66	Capacitor, ceramic	2200 µµf	CCG 94/2200
67	Capacitor, MP	16 µf/250 v	CPM 16/250
68	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
69	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
72	Capacitor, MP	8 µf/250 v	CMR 8/250
73	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
74	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
75	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
76	Capacitor, ceramic	2200 µµf	CCG 94/2200
77	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
78	Capacitor, ceramic	470 µµf	CCG 94/470
79	Capacitor, MP	8 µf/250 v	CMR 8/250
80	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
81	Capacitor, MP	0.5 µf/250 v	CPM 0,5/250/2
82	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
85	Capacitor, ceramic	2200 µµf	CCG 94/2200
86	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
87	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
88	Capacitor, MP	8 + 8 µf/250 v	CMR 8 + 8/250
91	Capacitor, MP	8 µf/250 v	CMR 8/250
92	Capacitor, synth. foil Capacitor, ceramic	40 µµf ±2.5%/500 v 8 µµf	CKD 2/40/2,5/500 CCH 31/8 parallel
93	Capacitor, synth. foil	500 µµf ±1%/500 v	CKS 500/1/500
94	Capacitor, synth. foil	5000 µµf ±1%/500 v	CKS 5000/1/500

Ref. No.	Designation	Ratings	R&S Stock No.
C95	Capacitor, synth. foil	50,000 µµf ±1%/500 v	CKS 50 000/1/500
C96	Capacitor, MP Capacitor, paper	2 x 16 µf/160 v 100,000 µµf/250 v	2 x CMR 16/160/2 CPK 100 000/250 parallel
C97	Capacitor, paper	25,000 µµf/250 v	CPK 25 000/250
C99	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
C100	Capacitor, elektrolytic	100 µf/15 v	CED 21/100/15
C101	Capacitor, synth. foil	120 µµf ±2.5%/500 v	CKD 2/120/2,5/500
C102	Capacitor, synth. foil	400 µµf ±2%/1000 v	CKS 400/2/1000
C103	Capacitor, synth. foil	1200 µµf ±2%/500 v	CKS 1200/2/500
C104	Capacitor, synth. foil	4000 µµf ±2%/500 v	CKS 4000/2/500
C105	Capacitor, synth. foil	12,000 µµf ±2%/500 v	CKS 12 000/2/500
C106	Capacitor, synth. foil	40,000 µµf ±2%/500 v	CKS 40 000/2/500
C107	Capacitor, paper	120,000 µµf ±2%/700 v	CPV 120 000/2/700 B
C108	Capacitor, paper	400,000 µµf ±2%/500 v	CPV 400 000/2/500 B
C109	Capacitor, paper	1.2 µf ±2%/500 v	CPV 1,2/2/500 B
C201	Capacitor, MP	2 x 8 µf/500 v	2 x CMR 8/500 parallel
C202	Capacitor, MP	16 µf/500 v	CMR 16/500
C203	Capacitor, MP	4 µf/500 v	CMR 4/500
C204	Capacitor, MP	4 µf/350 v	CMR 4/350
C205	Capacitor, paper	25,000 µµf/500 v	CPK 25 000/500
C208	Capacitor, electrolytic	5000 µf/12 v	CEG 6/5000/12
C210	Capacitor, MP	8 µf/250 v	CMR 8/250
G11	Diode, crystal		GK 2501
G12	Diode, crystal		GK 2501
G13	Diode, crystal		GK 2561
G14	Diode, crystal		GK 2561

Ref. No.	Designation	Ratings	R&S Stock No.
G16	Diode, crystal		GK 2501
G17	Diode, crystal		GK/S 33
G18	Diode, crystal		GK/S 33
G110	Diode, crystal		GK 2501
G111	Diode, crystal		GK 2501
G112	Diode, crystal		GK 2501
G114	Diode, crystal		2 x GK 2501 parallel
G115	Diode, crystal		2 x GK 2501 parallel
G1201	Rectifier	250 v/120 ma	GNV 19/250/120 M
G1202	Rectifier	250 v/120 ma	GNV 19/250/120 M
G1203	Rectifier	25 v/450 ma	GNB 14/25/450
G1204	Rectifier	250 v/30 ma	GNB 14/250/30
I1	Ammeter, moving-coil	1 ma	INS 41502
I2	Ammeter, moving-coil	40 µa	INS 20205
K1	Cable, r-f		LKK 61900
K2	Cable, r-f		LKK 61900
K3	Cable, r-f		LKK 61900
K4	Cable, r-f		LKK 61900
K5	Cable, r-f		LKK 61900
K6	Jumper, stranded, shielded		LLA 10 x 0,1
K7	Cable, two-wire, shielded		LK/YL (C) Y 2 x 0,2
K8	Cable, two-wire, shielded		LK/YL (C) Y 2 x 0,2
K9	Cable, two-wire, shielded		LK/YL (C) Y 2 x 0,2
K10	Cable, connecting		LK 333

Ref. No.	Designation	Ratings	R&S Stock No.
L1	Coil, (low-pass filter)	1.7...3.2 µh	444461 - 7.40
L2	Choke, r-f	2.1...4 µh	444521 - 1.14
L3	Choke, r-f		444521 - 1.15
L5	Coil, (low-pass filter)	1.6 h	444521 - 1.2.12
L6	Coil, (low-pass filter)	1.6 h	444521 - 1.2.12
L7	Coil, (low-pass filter)	1.6 h	444521 - 1.2.12
L8	Coil, (low-pass filter)	40 mh	47051 - 1.21.1
L9	Coil, (low-pass filter)	40 mh	47051 - 1.21.1
L10	Coil, (low-pass filter)	40 mh	47051 - 1.21.1
L11	Coil, (low-pass filter)	3.4 mh	47051 - 1.22.1
L12	Coil, (low-pass filter)	3.4 mh	47051 - 1.22.1
L13	Coil, (low-pass filter)	3.4 mh	47051 - 1.22.1
L201	Choke		DB 125/2
Mo1	Motor		ZAM 17001
R1	Resistor, depos. carbon	60 Ω/0.25 w	WF 60/0,25
R2	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R3	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R4	Resistor, depos. carbon	500 Ω/0.25 w	WF 500/0,25
R5	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R6	Resistor, depos. carbon	20 kΩ/0.25 w	WF 20 k/0,25
R7	Resistor, depos. carbon	600 Ω/0.25 w	WF 600/0.25
R10	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R11	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R12	Resistor, depos. carbon	20 kΩ/0.25 w	WF 20 k/0,25
R13	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R14	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R15	Resistor, depos. carbon	10 kΩ/0.1 w	WF 10 k/0,1

Ref. No.	Designation	Ratings	R&S Stock No.
R16	Resistor, depos. carbon	60 Ω/0.1 w	WF 60/0,1
R17	Resistor, depos. carbon	10 kΩ/0.1 w	WF 10 k/0,1
R20	Resistor, depos. carbon	60 Ω/0.25 w	WF 60/0,25
R21	Resistor, depos. carbon	60 Ω/0.25 w	WF 60/0,25
R22	Resistor, depos. carbon	5 kΩ/0.1 w	WF 5 k/0,1
R23	Resistor, depos. carbon	200 kΩ/0.1 w	WF 200 k/0,1
R24	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R25	Resistor, depos. carbon	10 kΩ/0.1 w	WF 10 k/0,1
R26	Resistor, depos. carbon	250 Ω/0.1 w	WF 250/0,1
R27	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R30	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R31	Resistor, depos. carbon	400 kΩ/0.25 w	WF 400 k/0,25
R32	Resistor, depos. carbon	60 kΩ/0.25 w	WF 60 k/0,25
R33	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R34	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R35	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R36	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R37	Resistor, depos. carbon	700 Ω ±1%/0.5 w	WF 700/1/0,5
R38	Resistor, depos. carbon	250 Ω ±1%/0.5 w	WF 250/1/0,5
R39	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R40	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R41	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R42	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R45	Resistor, depos. carbon	60 kΩ/0.1 w	WF 60 k/0,1
R46	Resistor, depos. carbon	40 kΩ/0.1 w	WF 40 k/0,1
R47	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R48	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R49	Resistor, depos. carbon	8 kΩ/1 w	WF 8 k/1

Ref. No.	Designation	Ratings	R&S Stock No.
R50	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R51	Resistor, depos. carbon	40 kΩ/0.1 w	WF 40 k/0,1
R52	Resistor, depos. carbon	40 kΩ/0.1 w	WF 40 k/0,1
R53	Resistor, depos. carbon	30 kΩ/0.25 w	WF 30 k/0,25
R54	Resistor, depos. carbon	125 kΩ/0.5 w	WF 125 k/0,5
R57	Resistor, depos. carbon	80 kΩ/0.25 w	WF 80 k/0,25
R58	Resistor, depos. carbon	500 kΩ/0.1 w	WF 500 k/0,1
R59	Resistor, depos. carbon	50 kΩ/0.1 w	WF 50 k/0,1
R60	Resistor, depos. carbon	500 kΩ/0.1 w	WF 500 k/0,1
R61	Resistor, depos. carbon	50 kΩ/0.1 w	WF 50 k/0,1
R62	Resistor, depos. carbon	80 kΩ/0.5 w	WF 80 k/0,5
R63	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R64	Resistor, depos. carbon	8 kΩ/0.5 w	WF 8 k/0,5
R65	Resistor, depos. carbon, variable	10 kΩ lin.	WS 7126/10 k
R66	Resistor, depos. carbon	6 kΩ/0.5 w	WF 6 k/0,5
R67	Resistor, depos. carbon	1.25 kΩ/0.25 w	WF 1,25 k/0,25
R71	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R72	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R73	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R74	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R75	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R76	Resistor, depos. carbon	2 MΩ/0.5 w	WF 2 M/0,5
R77	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R78	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R79	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R80	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R81	Resistor, depos. carbon	1 kΩ/1 w	WF 1 k/1

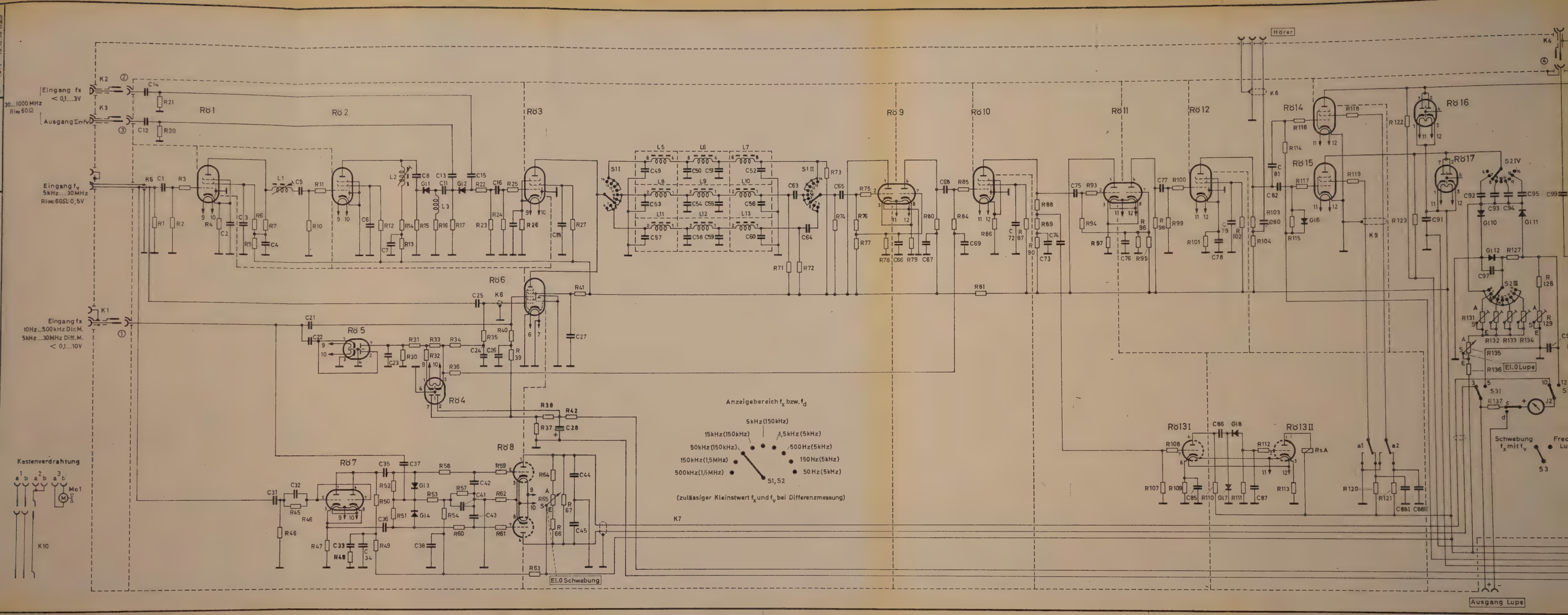
Ref. No.	Designation	Ratings	R&S Stock No.
R84	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R85	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R86	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R87	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R88	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R89	Resistor, depos. carbon	2.5 kΩ/0.5 w	WF 2,5 k/0,5
R90	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R93	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R94	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R95	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R96	Resistor, depos. carbon	40 kΩ/0.5 w	WF 40 k/0,5
R97	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R98	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R99	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R100	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R101	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R102	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R103	Resistor, depos. carbon	4 kΩ/0.5 w	WF 4 k/0,5
R104	Resistor, depos. carbon	500 Ω/0.5 w	WF 500/0,5
R107	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R108	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R109	Resistor, depos. carbon	250 Ω/0.25 w	WF 250/0,25
R110	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R111	Resistor, depos. carbon	2.5 MΩ/0.5 w	WF 2,5 M/0,5
R112	Resistor, depos. carbon	50 kΩ/0.1 w	WF 50 k/0,1
R113	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R114	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25

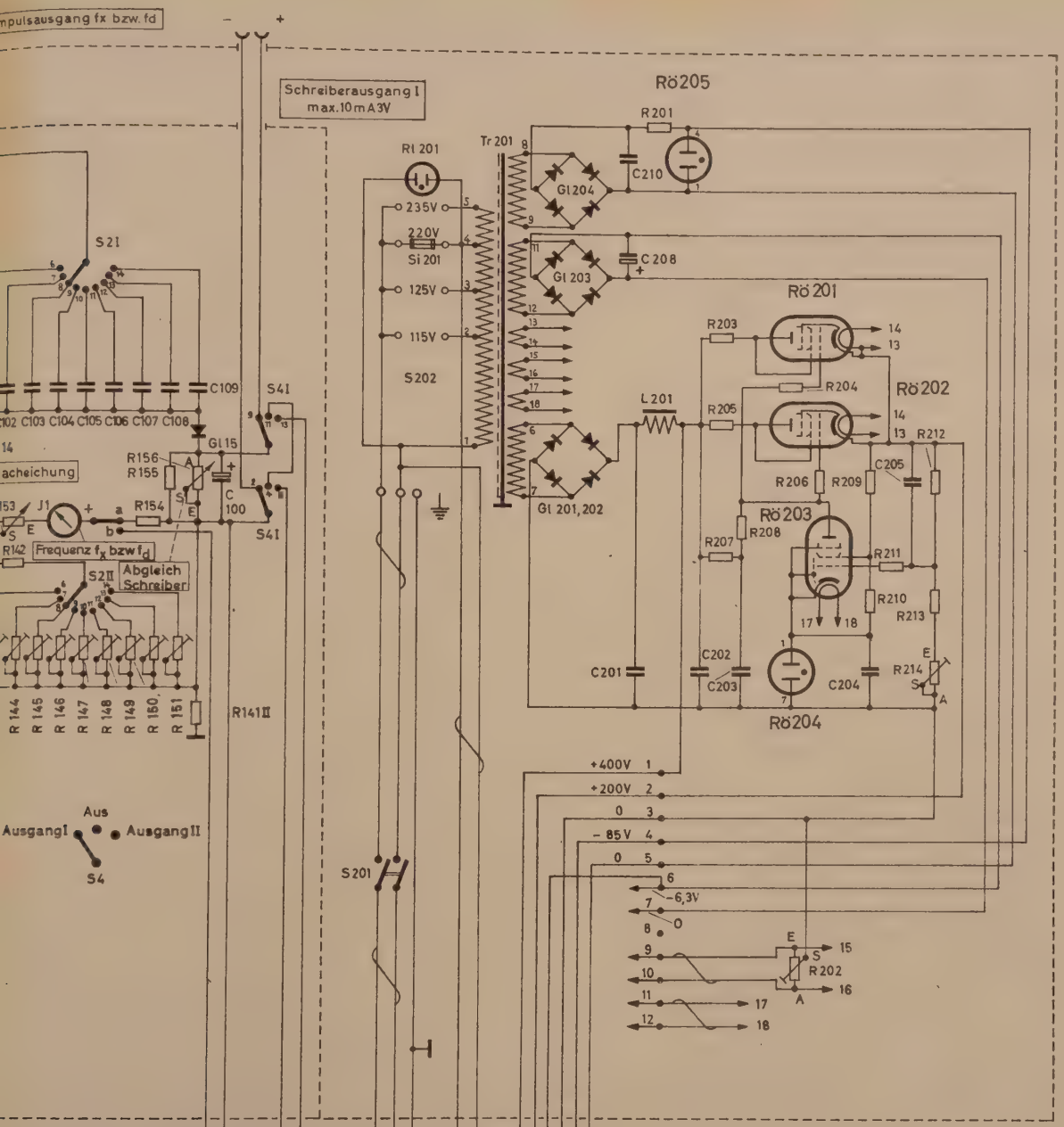
Ref. No.	Designation	Ratings	R&S Stock No.
R115	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R116	Resistor, depos. carbon	50 Ω/0.1 w	WF 50/0,1
R117	Resistor, depos. carbon	50 Ω/0.1 w	WF 50/0,1
R118	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R119	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R120	Resistor, wire-wound	6 kΩ/2 w	WDG 6 k/2
R121	Resistor, wire-wound	6 kΩ/2 w	WDG 6 k/2
R122	Resistor, depos. carbon	3 x 16 kΩ ±1%/6 w	3 x WF 16 k/1/6 parallel
R123	Resistor, depos. carbon	2 x 60 kΩ/2 w	2 x WF 60 k/2 parallel
R127	Resistor, depos. carbon	250 Ω/0.5 w	WF 250/0,5
R128	Resistor, depos. carbon	5 kΩ/1 w	WF 5 k/1
R129	Resistor, wire-wound, variable	5 kΩ lin.	WR 4 F/5 k
R131	Resistor, wire-wound, variable	5 kΩ lin.	WR 4 F/5 k
R132	Resistor, wire-wound, variable	5 kΩ lin.	WR 4 F/5 k
R133	Resistor, wire-wound, variable	5 kΩ lin.	WR 4 F/5 k
R134	Resistor, wire-wound, variable	5 kΩ lin.	WR 4 F/5 k
R135	Resistor, wire-wound, variable	20 kΩ lin.	WR 10/20 k
R136	Resistor, wire-wound	195 kΩ/1 w	WDF 61/195 k/1
R137	Resistor, depos. carbon	250 Ω/0.5 w	WF 250/0,5
R141	Resistor, wire-wound		47051 - 1.24
R142	Resistor, depos. carbon	125 Ω/1 w	WF 125/1
R143	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R144	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100

Ref. No.	Designation	Ratings	R&S Stock No.
R145	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R146	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R147	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R148	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R149	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R150	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R151	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R153	Resistor, wire-wound, variable	100 Ω lin.	WR 4/100
R154	Resistor, depos. carbon	10 Ω/0.25 w	WF 10/0,25
R155	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R156	Resistor, depos. carbon, variable	10 kΩ log.	WS 7226/10 k
R201	Resistor, wire-wound	2 x 5 kΩ/2 w	2 x WDG 5 k/2 in series
R202	Resistor, wire-wound, variable	100 Ω lin.	WR 4 F/100
R203	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R204	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R205	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R206	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R207	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R208	Resistor, depos. carbon	1 MΩ/1 w	WF 1 M/1
R209	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R210	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R211	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1

Ref. No.	Designation	Ratings	R&S Stock No.
R212	Resistor, depos. carbon	400 kΩ/0.5 w	WF 400 k/0,5
R213	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R214	Resistor, depos. carbon, variable	100 kΩ lin.	WS 9122 F/100 k
R1201	Miniature glow lamp	220 v	RL 210
Rö1	Pentode		EF 80
Rö2	Pentode		EF 800
Rö3	Pentode		EF 800
Rö4	Duo-diode		EAA 91
Rö5	Duo-diode		EAA 91
Rö6	Triode-Heptode		ECH 81
Rö7	Duo-triode		ECC 81
Rö8	Duo-triode		ECC 81
Rö9	Duo-triode		ECC 81
Rö10	Pentode		EF 80
Rö11	Duo-triode		ECC 81
Rö12	Pentode		EF 80
Rö13	Duo-triode		ECC 81
Rö14	Pentode, output		EL 86
Rö15	Pentode, output		EL 86
Rö16	Duo-diode		EAA 91
Rö17	Duo-diode		EAA 91
Rö201	Pentode, output		EL 86
Rö202	Pentode, output		EL 86
Rö203	Pentode		EF 80
Rö204	Reference tube		85 A 2
Rö205	Reference tube		85 A 2

Ref. No.	Designation	Ratings	R&S Stock No.
RsA	Relay		RSS 125042
S1	Switch, step		SRW 14213
S2	Switch, step		SRW 14410
S3	Switch, step		SRW 07120
S4	Switch, step		SRW 07120
S201	Switch (combination)		SRK 1
S202	Fuse strip		FD 603/2
Si201	Fuse	1 amp	1 C DIN 41571
Tr201	Transformer, power		47051 - 2.5


Eingang fx
< 0,1...3V
30...1000 MHz
Ri≈60Ω
Ausgang Σm-Nf
Eingang fv
5kHz...30MHz
Ri≈60Ω 0,5V
Eingang fx
10Hz...500kHz Dir.M.
5kHz...30MHz Diff.M.
< 0,1...10V
Kastenverdrahtung
Mo1
K10
Rö1
Rö2
Rö3
Rö4
Rö5
Rö6
Rö7
Rö8
Rö9
Rö10
Rö11
Rö12
Rö13 I
Rö13 II
Rö14
Rö15
Rö16
Rö17
Hörer
K8
K9
S11
S11 II
S2 IV
S2 III
S31
S3
S1, S2
Anzeigebereich fx bzw. fd
5kHz(150kHz)
15kHz(150kHz)
1,5kHz(5kHz)
50kHz(150kHz)
500Hz(5kHz)
150kHz(1,5MHz)
150Hz(5kHz)
500kHz(1,5MHz)
50Hz(5kHz)
(zulässiger Kleinstwert fx und fv bei Differenzmessung)
El.0 Schwebung
El.0 Lupe
Schwebung fx mit fv
Ausgang Lupe
K7



Rö 1, 10, 12 u. 203
EF 80

Rö 2 u. 3
EF 800

Rö 4, 5, 16 u. 17
EAA 91

Rö 6
ECH 81

Rö 7, 8, 9, 11 u. 13
ECC 81

Rö 14, 15, 201 u. 202
EL 86

Rö 204 u. 205
85 A 2

R 5965 Bl. 14

Gilt nur für Komm. 1180, 1243

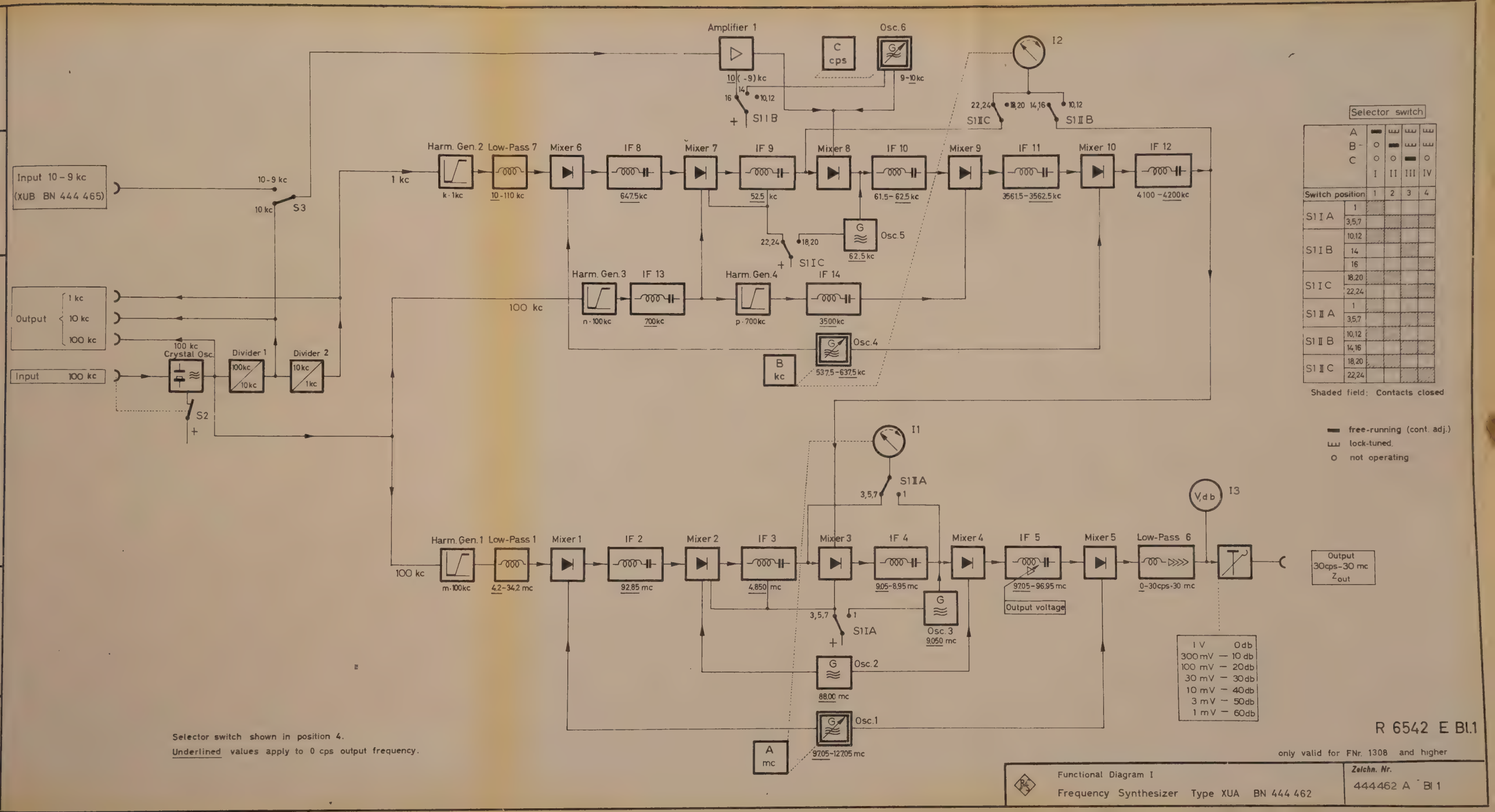
hierzu Schaltteilliste 47051 Sa

Stromlauf zu

Frequenzzeiger Type FKM BN 47051

Zeichn. Nr.

47051 S



Selector switch

		A	B	C
		I	II	III	IV
Switch position		1	2	3	4
S1IA	1				
	3,5,7				
S1IB	10,12				
	14				
	16				
S1IC	18,20				
	22,24				
S1IIA	1				
	3,5,7				
S1IIB	10,12				
	14,16				
S1IIC	18,20				
	22,24				

Shaded field: Contacts closed

▬ free-running (cont. adj.)
⊔⊔ lock-tuned.
o not operating

Selector switch shown in position 4.
Underlined values apply to 0 cps output frequency.

R 6542 E Bl.1

only valid for FNr. 1308 and higher

Functional Diagram I
Frequency Synthesizer Type XUA BN 444 462

Zeichn. Nr.
444462 A Bl 1

Table of Replaceable Parts for Frequency Synthesizer Type XUA

(Gültig für Komm. 1308 und 1340)

Ref. No.	Designation	Ratings	R&S Stock No.
C1	Capacitor, paper	10,000 µµf/250 v	CPK 10 000/250
C2	Capacitor, synth. foil	50,000 µµf ±2%/250 v	CKS 50 000/2/250
C3	Capacitor, paper	10,000 µµf/630 v	CPK 10 000/630
C4	Capacitor, MP	1 µf/250 v	CMR 1/250/1
C5	Capacitor, paper	100 000 µµf/250 v	CPK 100 000/250
C6	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C7	Capacitor, MP	8 µf/250 v	CMR 8/250
C8	Capacitor, paper	10,000 µµf/250 v	CPK 10 000/250
C9	Capacitor, paper	10,000 µµf/250 v	CPK 10 000/250
C10	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
C11	Capacitor, synth. foil	800 µµf/500 v	CKS 800/500
C12	Capacitor, synth. foil	1600 µµf/500 v	CKS 1600/500
C13	Capacitor, synth. foil	1600 µµf/500 v	CKS 1600/500
C14	Capacitor, synth. foil	800 µµf/500 v	CKS 800/500
C15	Capacitor, paper	250,000 µµf/250 v	CPK 250 000/250
C16	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C17	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C18	Capacitor, paper, feed-through	10,000 µµf/300 v	CPM 10 000/300
C19	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C20	Capacitor, ceramic	0.5 µµf	CCG 11/0,5
C21	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C22	Capacitor, ceramic	1.0 µµf	CCG 11/1

Ref. No.	Designation	Ratings	R&S Stock No.
C23	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C24	Capacitor, ceramic	0.5 µµf	CCG 11/0,5
C25	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C26	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C27	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C28	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C29	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C30	Capacitor, ceramic	8 µµf	CCG 41/8
C31	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C32	Capacitor, ceramic	8 µµf	CCG 41/8
C33	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C34	Capacitor, ceramic	8 µµf	CCG 41/8
C35	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C36	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C37	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
C38	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C39	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C40	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C41	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C42	Capacitor, ceramic	8 µµf	CCG 41/8
C43	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C44	Capacitor, ceramic	8 µµf	CCG 41/8

Ref. No.	Designation	Ratings	R&S Stock No.
C45	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C46	Capacitor, ceramic	8 µµf	CCG 41/8
C47	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C48	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C49	Capacitor, synth. foil	80 µµf/500 v	CKD 2/80/500
C50	Capacitor, synth. foil	200 µµf/500 v	CKD 2/200/500
C51	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C52	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C53	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C54	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C55	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C56	Capacitor, mica	1000 µµf ±2%/500 v	CGT 1000/2/500 DD 1
C57	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C58	Trimmer, air	4...29 µµf	CV 8025
C59	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C60	Capacitor, ceramic	47 µµf	CCH 31/47
C61	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C62	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C63	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C64	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
C65	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C66	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C67	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C68	Capacitor, ceramic	27 µµf	CCH 31/27

Ref. No.	Designation	Ratings	R&S Stock No.
C69	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C70	Capacitor, ceramic	27 µµf	CCH 31/27
C71	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025 parallel
C72	Capacitor, ceramic	27 µµf	CCH 31/27
C73	Capacitor, mica Trimmer, air	1000 µµf ±2%/500 v 4...29 µµf	CGT 1000/2/500 DD 1 CV 8025
C74	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
C75	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C76	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C77	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C78	Capacitor, ceramic	1 µµf	CCG 21/1
C79	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C80	Capacitor, ceramic	1 µµf	CCG 21/1
C81	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C82	Capacitor, ceramic	1 µµf	CCG 21/1
C83	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C84	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C85	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C86	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C87	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C88	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C89	Capacitor, ceramic	1 µµf	CCG 21/1
C90	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel

Ref. No.	Designation	Ratings	R&S Stock No.
C91	Capacitor, ceramic	1 µµf	CCG 21/1
C92	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C93	Capacitor, ceramic	1 µµf	CCG 21/1
C94	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C95	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C96	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C97	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C98	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C99	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C100	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C101	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C102	Capacitor, synth. foil	100 µµf/500 v	CKD 2/100/500
C103	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C104	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C105	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C106	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C107	Capacitor, ceramic Trimmer, air	39 µµf 4...29 µµf	CCH 31/39 CV 8025 parallel
C108	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C109	Capacitor, synth. foil	125 µµf/125 v	CKD 1/125/125
C110	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C111	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C112	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250

Ref. No.	Designation	Ratings	R&S Stock No.
C113	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C116	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C117	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C118	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C119	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C120	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C121	Capacitor, mica Trimmer, air	400 µµf ±5%/500 v 4...29 µµf	CGT 400/5/500 DD 1 CV 8025 parallel
C122	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C123	Capacitor, synth. foil	100 µµf/500 v	CKD 2/100/500
C124	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C125	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C126	Capacitor, paper	25,000 µµf/250 v	CPM 25 000/250
C127	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C128	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C129	Capacitor, ceramic	1 µµf	CCG 21/1
C130	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C131	Capacitor, ceramic	1 µµf	CCG 21/1
C132	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C133	Capacitor, ceramic	1 µµf	CCG 21/1
C134	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C135	Capacitor, synth. foil	50 µµf/500 v	CKD 2/50/500
C136	Capacitor, synth. foil	160 µµf/500 v	CKD 2/160/500

Ref. No.	Designation	Ratings	R&S Stock No.
C137	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C138	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C139	Capacitor, ceramic	1 µµf	CCG 21/1
C140	Capacitor, ceramic Trimmer, air	2 x 62 µµf 4...29 µµf	2 x CCH 31/62 CV 8025 parallel
C141	Capacitor, synth. foil	160 µµf/500 v	CKD 2/160/500
C142	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C143	Capacitor, ceramic	3 µµf	CCG 41/3
C144	Capacitor, ceramic	5 µµf	CCG 41/5
G11	Diode, crystal		GK 2561
G12	Diode, crystal		GK 2561
G13	Diode, crystal		GK 2561
K1	Wire, stranded, shielded		LKK 61900
K2	Cable		R 6422/160
K3	Cable		R 6422/140
K4	Cable		R 6422/130
K5	Cable		R 6422/62
K6	Wire, stranded, shielded		LKK 61900
K7	Wire, stranded, shielded		LKK 61900
K8	Wire, stranded, shielded		LKK 61900
K9	Wire, stranded, shielded		LKK 61900
K10	Wire, stranded, shielded		LKK 61900
K11	Cable		444462 - 12/90
K12	Cable		444462 - 12/100
K13	Cable		444462 - 12/70
K14	Cable, r-f		LK 126/6

Ref. No.	Designation	Ratings	R&S Stock No.
K16	Wire, stranded, shielded		LKK 61900
K17	Wire, stranded, shielded		LKK 61900
K19	Cable, r-f		
K20	Cable, r-f		
K21	Cable, r-f		
K22	Cable, r-f		
K23	Cable, shielded		LKK 92220
K24	Cable, shielded		LKK 92220
K25	Cable, shielded		LKK 92220
K26	Cable, shielded		LKK 92220
K27	Wire, twin, stranded, shielded		LFA 03022
K28	Wire, twin, stranded, shielded		LFA 03022
K29	Cable, shielded		LKK 92220
K30	Cable, shielded		LKK 92220
K31	Cable, shielded		LKK 92220
K33	Cable, shielded		LKK 92220
L1	Coil	500 mH	444461 - 6.16.2
L2	Coil	400 µH	444461 - 6.9.16
L3	Coil, (low-pass filter)	3,9 mH	444461 - 6.9.10/3
L4	Coil, (low-pass filter)	3,9 mH	444461 - 6.9.10
L5	Coil, (low-pass filter)	3,9 mH	444461 - 6.9.10/1
L6	Coil	100 mH	444461 - 6.16.3
L7	Coil	400 µH	444461 - 6.3.10/1
L8	Coil	400 µH	444461 - 6.3.11/1
L9	Coil	400 µH	444461 - 6.3.11/1
L10	Coil	400 µH	444461 - 6.3.10/1

Ref. No.	Designation	Ratings	R&S Stock No.
L11	Coil	8,9 mH	444461 - 6.11.3
L12	Coil	8,9 mH	444461 - 6.11.4
L13	Coil	8,9 mH	444461 - 6.11.4
L14	Coil	8,9 mH	444461 - 6.11.4/1
L15	Coil	8,9 mH	444461 - 6.11.3
L16	Coil	8,9 mH	444461 - 6.11.4
L17	Coil	8,9 mH	444461 - 6.11.4
L18	Coil	8,9 mH	444461 - 6.11.4/3
L19	Coil	6,4 mH	444461 - 6.13.3
L20	Coil	6,4 mH	444461 - 6.13.4
L21	Coil	6,4 mH	444461 - 6.13.4
L22	Coil	6,4 mH	444461 - 6.13.3
L23	Coil	13,6 µH	444461 - 6.4.1/1
L24	Coil	13,6 µH	444461 - 6.4.2/1
L25	Coil	13,6 µH	444461 - 6.4.2/1
L26	Coil	13,6 µH	444461 - 6.4.1/1
L27	Coil	13,6 µH	444461 - 6.4.2/1
L28	Coil	13,6 µH	444461 - 6.4.2/1
L29	Coil	13,6 µH	444461 - 6.4.2/1
L30	Coil	13,6 µH	444461 - 6.4.1/1
L31	Coil	9,9 µH	444461 - 7.51.3/1
L32	Coil	9,9 µH	444461 - 7.51.3/1
L33	Coil	9,9 µH	444461 - 7.51.3/1
L34	Coil	9,9 µH	444461 - 7.51.3/1
L35	Coil (tank circuit)	6 mH	444461 - 6.15.1/1
L37	Coil	6 mH	444461 - 7.50.1
L38	Coil	345 µH	444461 - 6.5.1/1

Ref. No.	Designation	Ratings	R&S Stock No.
L39	Coil	345 µH	444461 - 6.5.1/2
L40	Coil	345 µH	444461 - 6.5.1/1
L41	Coil	345 µH	444461 - 6.6.1/1
L42	Coil	13,6 µH	444461 - 6.4.2/1
L43	Coil	13,6 µH	444461 - 6.4.1/1
R1	Resistor, depos. carbon	250 kΩ/0.25 w	WF 250 k/0,25
R2	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R3	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R4	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R5	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R6	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R7	Resistor, depos. carbon	200 kΩ/0.5 w 20 kΩ/0.5 w	WF 200 k/0,5 WF 20 k/0,5 in series
R8	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R9	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R10	Resistor, depos. carbon	4 kΩ/2 w	WF 4 k/2
R11	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R12	Resistor, depos. carbon	2 kΩ/0.25 w	WF 2 k/0,25
R13	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R14	Resistor, depos. carbon	2 kΩ/0.25 w	WF 2 k/0,25
R15	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R16	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R17	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R18	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R19	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R20	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R21	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R22	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R23	Resistor, depos. carbon	2 kΩ/0.25 w	WF 2 k/0,25
R24	Resistor, wire-wound, variable	5 kΩ lin.	WR 4 F/5 k
R25	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R26	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R27	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R28	Resistor, depos. carbon	500 Ω/0.25 w	WF 500/0,25
R29	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R30	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R31	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R32	Resistor, depos. carbon	250 kΩ ±1%/0.5 w	WF 250 k/1/0,5
R33	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R34	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R35	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R36	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R37	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R38	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R40	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R41	Resistor, depos. carbon	1.6 MΩ/0.5 w	WF 1,6 M/0,5
R42	Resistor, depos. carbon	200 kΩ/0.1 w	WF 200 k/0,1
R43	Resistor, depos. carbon	200 kΩ/0.1 w	WF 200 k/0,1
R44	Resistor, depos. carbon	200 kΩ/0.1 w	WF 200 k/0,1
R45	Resistor, depos. carbon	200 kΩ/0.1 w	WF 200 k/0,1
R46	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R47	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R48	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R49	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R50	Resistor, depos. carbon	800 Ω/0.25 w	WF 800/0,25
R51	Resistor, depos. carbon	250 kΩ/0.5 w	WF 250 k/0,5
R52	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R53	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R54	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R55	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R56	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R57	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R58	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R59	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R60	Resistor, depos. carbon	30 kΩ/0.1 w	WF 30 k/0,1
R61	Resistor, depos. carbon	30 kΩ/0.1 w	WF 30 k/0,1
R62	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R63	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R64	Resistor, depos. carbon, variable	500 kΩ lin.	WS 9122 F/500 k
R65	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R66	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R67	Resistor, depos. carbon	12.5 kΩ/0.1 w	WF 12,5 k/0,1
R68	Resistor, depos. carbon	12.5 kΩ/0.1 w	WF 12,5 k/0,1
R69	Resistor, depos. carbon	16 kΩ ±1%/0.5 w	WF 16 k/1/0,5
R71	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R72	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R73	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R74	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R75	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R76	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R77	Resistor, depos. carbon	6 kΩ/0.25 w	WF 6 k/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R79	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R80	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R81	Resistor, depos. carbon	5 MΩ/0.5 w	WF 5 M/0,5
R82	Resistor, depos. carbon	1.25 MΩ/0.5 w	WF 1,25 M/0,5
R83	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R84	Resistor, depos. carbon	10 MΩ/0.5 w	WF 10 M/0,5
R85	Resistor, depos. carbon	800 kΩ/0.5 w	WF 800 k/0,5
R86	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R88	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R89	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R90	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R91	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R92	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R93	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R94	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R95	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
Rö1	Pentode		EF 80
Rö2	Pentode		EF 80
Rö3	Pentode		EF 80
Rö4	Triode-Hexode		ECH 81
Rö5	Triode-Hexode		ECH 81
Rö6	Pentode		EF 80
Rö7	Triode-Hexode		ECH 81
Rö8	Triode-Hexode		ECH 81
Rö9	Pentode		EF 80
Rö10	Triode-Hexode		ECH 81
Rö11	Pentode		EF 80

Ref. No.	Designation	Ratings	R&S Stock No.
Rö12	Pentode		EF 80
Rö13	Pentode		EF 80
Rö14	Pentode		EF 80
Rö15	Pentode		EF 80
Rö16	Pentode		EF 80
C161	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C162	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C163	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C164	Capacitor, mica Trimmer, air	400 µµf ±5%/500 v 4...29 µµf	CGT 400/5/500 DD 1 CV 8025 parallel
C165	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C166	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C167	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C168	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C169	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C170	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C171	Capacitor, MP	1 µf/250 v	CMR 1/250/1
C172	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C173	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C174	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C175	Capacitor, synth. foil	50 µµf/500 v	CKD 2/50/500
C176	Capacitor, ceramic	8 µµf	CCG 41/8
C177	Capacitor, ceramic	27 µµf	CCH 31/27
C178	Capacitor, ceramic	10 µµf	CCG 41/10
C179	Capacitor, ceramic	27 µµf	CCH 31/27
C180	Capacitor, ceramic	5 µµf	CCG 41/5
C181	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350

Ref. No.	Designation	Ratings	R&S Stock No.
C182	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C183	Capacitor, ceramic	30 µµf	CCH 31/30
C184	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C185	Capacitor, ceramic	1 µµf	CCG 21/1
C186	Capacitor, ceramic	30 µµf	CCH 31/30
C187	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C188	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C189	Capacitor, ceramic	27 µµf	CCH 31/27
C190	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C191	Capacitor, ceramic	2 µµf	CCG 41/2
C192	Capacitor, ceramic	30 µµf	CCH 31/30
C193	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C194	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C195	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4...29 µµf	2 x CCH 31/47 CV 8025 parallel
C196	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C197	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4...29 µµf	2 x CCH 31/47 CV 8025 parallel
C198	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C199	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C200	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4...29 µµf	2 x CCH 31/47 CV 8025 parallel
C201	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C202	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4..29 µµf	2 x CCH 31/47 CV 8025 parallel
C203	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C204	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250

Ref. No.	Designation	Ratings	R&S Stock No.
C205	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4...29 µµf	2 x CCH 31/47 CV 8025 parallel
C206	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C207	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4...29 µµf	2 x CCH 31/47 CV 8025 parallel
C208	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C209	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C210	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4..29 µµf	2 x CCH 31/47 CV 8025 parallel
C211	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C212	Capacitor, ceramic Trimmer, air	2 x 47 µµf 4...29 µµf	2 x CCH 31/47 CV 8025 parallel
C213	Capacitor, paper	5000 µµf/500 v	CPM 5000/500
C214	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C215	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C216	Capacitor, ceramic Trimmer, air	39 µµf 4...29 µµf	CCH 31/39 CV 8025 parallel
C217	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C218	Capacitor, ceramic Trimmer, air	39 µµf 4...29 µµf	CCH 31/39 CV 8025 parallel
C219	Capacitor, ceramic	1 µµf	CCG 21/1
C220	Capacitor, ceramic Trimmer, air	39 µµf 4...29 µµf	CCH 31/39 CV 8025 parallel
C221	Capacitor, ceramic Trimmer, air	39 µµf 4...29 µµf	CCH 31/39 CV 8025 parallel
C222	Capacitor, ceramic	4 µµf	CCG 41/4
C223	Capacitor, synth. foil	10,000 µµf/125 v	CKS 10 000/125
C224	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C225	Capacitor, ceramic	30 µµf	CCH 31/30
C226	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C227	Capacitor, ceramic	0.5 µµf	CCG 11/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
C228	Capacitor, ceramic	30 µµf	CCH 31/30
C229	Capacitor, ceramic	2200 µµf	CCG 94/2200
C230	Capacitor, ceramic	2200 µµf	CCG 94/2200
C231	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C232	Capacitor, ceramic	33 µµf	CCH 31/33
C233	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C234	Capacitor, ceramic	0.5 µµf	CCG 11/0,5
C235	Capacitor, ceramic	33 µµf	CCH 31/33
C236	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C237	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C238	Capacitor, MP	8 µf/250 v	CMR 8/250
C239	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C240	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C241	Capacitor, MP	1 µf/250 v	CMR 1/250/1
C242	Capacitor, MP	8 µf/250 v	CMR 8/250/2
C243	Capacitor, paper	10,000 µµf/250 v*	CPM 10 000/250*
C244	Capacitor, paper	25,000 µµf/630 v	CPK 25 000/630
C245	Capacitor, synth. foil	100 µµf/500 v	CKD 2/100/500
C246	Capacitor, mica	450 µµf ±5%/500 v	CGT 450/5/500 DD 1
C247	Capacitor, paper	10,000 µµf/250 v*	CPM 10 000/250*
C248	Trimmer, air	4...29 µµf	CV 8125
C249	Capacitor, paper	25,000 µµf/630 v	CPK 25 000/630
C250	Capacitor, ceramic	56 µµf	CCK 41/56
C251	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C252	Capacitor, mica	450 µµf ±5%/500 v	CGT 450/5/500 DD 1

* 10000µµf/500 v for Nr. 1340/...

* CPM 10000/500 for Nr. 1340/...

Ref. No.	Designation	Ratings	R&S Stock No.
C254	Capacitor, MP	8 µf/250 v	CMR 8/250
C255	Capacitor, paper	25,000 µµf/630 v	CPK 25 000/630
C256	Capacitor, ceramic	100 µµf	CCK 41/100
C257	Capacitor, mica	450 µµf ±5%/500 v	CGT 450/5/500 DD 1
C258	Capacitor, paper	10,000 µµf/250 v*	CPM 10 000/250 *
C259	Capacitor, paper	25,000 µµf/630 v	CPK 25 000/630
C260	Capacitor, ceramic	100 µµf	CCK 41/100
C261	Capacitor, ceramic	330 µµf	CCH 68/330
C262	Capacitor, MP	8 µf/250 v	CMR 8/250
C263	Capacitor, ceramic	8 µµf	CCG 41/8
C264	Capacitor, ceramic	30 µµf	CCH 31/30
C265	Capacitor, ceramic	47 µµf	CCH 31/47
C266	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C267	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C268	Capacitor, ceramic	39 µµf	CCH 31/39
C269	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C270	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C271	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C272	Capacitor, ceramic	18 µµf	CCH 31/18
C273	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C274	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C275	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C276	Capacitor, ceramic	12 µµf	CCH 31/12
C277	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350

* 10000 µµf/500 v for FNr. 1340/...

* CPM 10000/500 for FNr. 1340/...

Ref. No.	Designation	Ratings	R&S Stock No.
C278	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C279	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C280	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C281	Capacitor, ceramic	39 µµf	CCH 31/39
C282	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C283	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C284	Capacitor, ceramic	47 µµf	CCH 31/47
C285	Capacitor, synth. foil	80 µµf/500 v	CKD 2/80/500
C286	Capacitor, synth. foil	80 µµf/500 v	CKD 2/80/500
C287	Capacitor, synth. foil	100 µµf/500 v	CKD 2/100/500
C288	Capacitor, paper	10,000 µµf/250 v	CPM 10 000/250
C289	Trimmer, air	4...29 µµf	CV 8025
C290	Capacitor, MP	1 µf/250 v	CMR 1/250/1
C291	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C292	Capacitor, ceramic	1 µµf	CCG 21/1
C293	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C294	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C295	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C296	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C297	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C298	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C299	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300

Ref. No.	Designation	Ratings	R&S Stock No.
C319	Trimmer, tubular, ceramic	1...6 µµf	CV 7205
C320	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C321	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C322	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C323	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C324	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C325	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C326	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C327	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C328	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C329	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C330	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C331	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C332	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C333	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C334	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C335	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C336	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C337	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500

Ref. No.	Designation	Ratings	R&S Stock No.
C338	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C339	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C340	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C341	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C342	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C343	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C344	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C345	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C346	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C347	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C348	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C349	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C350	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C351	Capacitor, ceramic	1 µµf	CCG 11/1
C352	Capacitor, ceramic	1 µµf	CCG 11/1
C353	Capacitor, ceramic	0.5 µµf	CCG 11/0,5
C354	Capacitor, ceramic	0.5 µµf	CCG 11/0,5
C355	Capacitor, ceramic	1 µµf	CCG 21/1
C356	Capacitor, ceramic	1 µµf	CCG 21/1
C357	Capacitor, ceramic	2200 µµf	CCG 94/2200
C358	Capacitor, ceramic	2 µµf	CCG 41/2

Ref. No.	Designation	Ratings	R&S Stock No.
G110	Diode, crystal		GK 2561
G111	Diode, crystal		GK/S 33
K1	Wire, stranded, shielded		LKK 61900
K2	Cable		R 6422/160
K3	Cable		R 6422/140
K4	Cable		R 6422/130
K5	Cable		R 6422/62
K6	Wire, stranded, shielded		LKK 61900
K7	Wire, stranded, shielded		LKK 61900
K8	Wire, stranded, shielded		LKK 61900
K9	Wire, stranded, shielded		LKK 61900
K10	Wire, stranded, shielded		LKK 61900
K11	Cable		444462 - 12/90
K12	Cable		444462 - 12/100
K13	Cable		444462 - 12/70
K14	Cable, r-f		LK 126/6
K16	Wire, stranded, shielded		LKK 61900
K17	Wire, stranded, shielded		LKK 61900
K19	Cable, r-f		
K20	Cable, r-f		
K21	Cable, r-f		
K22	Cable, r-f		
K23	Cable, shielded		LKK 92220
K24	Cable, shielded		LKK 92220
K25	Cable, shielded		LKK 92220
K26	Cable, shielded		LKK 92220
K27	Wire, twin, stranded, shielded		LFA 03022

Ref. No.	Designation	Ratings	R&S Stock No.
K28	Wire, twin, stranded, shielded		LSA [illegible]
K29	Cable, shielded		LKK [illegible]
K30	Cable, shielded		LKK [illegible]
K31	Cable, shielded		LKK [illegible]
K33	Cable, shielded		LKK [illegible]
L51	Coil	6 mH	444461 - 7.50.1
L52	Coil	4.5 mH	444461 - 7.12
L53	Coil	2 mH	444461 - 7.41
L54	Coil, (low-pass filter)	1 mH	444461 - 7.42
L55	Coil	2 mH	444461 - 7.41
L56	Coil	8 mH	444461 - 7.9
L57	Coil	8 mH	444461 - 7.9
L58	Coil	8 mH	444461 - 7.9
L59	Coil	8 mH	444461 - 7.9
L60	Coil	9 mH	444461 - 7.51.3/1
L61	Coil	9 mH	444461 - 7.51.6/1
L62	Coil	9 mH	444461 - 7.51.3/1
L63	Coil	9 mH	444461 - 7.51.6/1
L64	Coil	9 mH	444461 - 7.51.3/1
L65	Coil	9 mH	444461 - 7.51.6/1
L66	Coil	9 mH	444461 - 7.51.3/1
L67	Coil	9 mH	444461 - 7.51.6/1
L68	Coil	4.5 mH	444461 - 7.52.1/1
L69	Coil	4.5 mH	444461 - 7.52.1/1
L70	Coil	4.5 mH	444461 - 7.52.1/1
L71	Coil	4.5 mH	444461 - 7.52.1/1

Ref. No.	Designation	Ratings	R&S Stock No.
L72	Coil	8 nH	444461 - 7.9
L73	Coil	8 nH	444461 - 7.9
L74	Coil	8 nH	444461 - 7.9
L75	Coil	8 nH	444461 - 7.9
L76	Coil	≈ 3 nH	444461 - 7.43
L77	Coil	2 µH	444461 - 7.41
L78	Coil, (low-pass filter)	2,5 µH	444461 - 7.40
L79	Coil, (low-pass filter)	2,5 µH	444461 - 7.40
L80	Coil, (low-pass filter)	2,5 µH	444461 - 7.40
L81	Coil	0,5 µH	444461 - 7.38
L84	Coil	8 nH	444461 - 7.9
L85	Coil	0,5 µH	444461 - 739
L86	Coil, (tank circuit)	0,7 µH	444461 - 7.39
L87	Coil	8 nH	444461 - 7.9
L88	Coil	≈ 60 mH	4421 - 8.11
L89	Choke	20 µH	DUF 311/20
L90	Choke	20 µH	DUF 311/20
L91	Choke	20 µH	DUF 311/20
L92	Choke	20 µH	DUF 311/20
L93	Choke	20 µH	DUF 311/20
L94	Choke	20 µH	DUF 311/20
L95	Choke	20 µH	DUF 311/20
L96	Choke	20 µH	DUF 311/20
L97	Choke	20 µH	DUF 311/20
L98	Choke	20 µH	DUF 311/20
L99	Choke	20 µH	DUF 311/20
L100	Choke	20 µH	DUF 311/20

Ref. No.	Designation	Ratings	R&S Stock No.
L101	Choke	20 µH	DUF 311/20
L103	Choke	20 µH	DUF 311/20
L104	Choke	20 µH	DUF 311/20
L105	Choke	20 µH	DUF 311/20
L106	Choke	20 µH	DUF 311/20
L107	Choke	20 µH	DUF 311/20
L108	Choke	20 µH	DUF 311/20
L109	Choke	20 µH	DUF 311/20
L110	Coil	4,5 µH	444461 - 7.12
L111	Coil	4,5 µH	444461 - 7.12
L116	Choke, heater	2 x 2 µH	444461 - 7.45
L117	Choke, heater	2 x 2 µH	444461 - 7.45
L118	Choke, heater	2 x 2 µH	444461 - 7.45
L119	Choke, heater	2 x 2 µH	444461 - 7.45
L120	Choke, heater	2 x 2 µH	444461 - 7.45
L121	Choke, heater	2 x 2 µH	444461 - 7.45
L122	Choke, heater	2 x 2 µH	444461 - 7.45
L123	Choke, heater	2 x 2 µH	444461 - 7.45
L124	Choke, heater	2 x 2 µH	444461 - 7.45
L125	Choke, heater	2 x 2 µH	444461 - 7.45
L126	Choke, heater	2 x 2 µH	444461 - 7.45
L127	Choke, heater	2 x 2 µH	444461 - 7.45
L128	Choke, heater	2 x 2 µH	444461 - 7.45
L129	Choke, heater	2 x 2 µH	444461 - 7.45
L130	Choke, heater	2 x 2 µH	444461 - 7.45
L131	Choke, heater	2 x 2 µH	444461 - 7.45
L132	Choke, heater	2 x 2 µH	444461 - 7.45

Ref. No.	Designation	Ratings	R&S Stock No.
L135	Choke, heater	2 x 2 µH	444461 - 7.45
L136	Choke, heater	2 x 2 µH	444461 - 7.45
L137	Choke, heater	2 x 2 µH	444461 - 7.45
L138	Choke, heater	2 x 2 µH	444461 - 7.45
L139	Choke, heater	2 x 2 µH	444461 - 7.45
Q1	Crystal (control)	44 mc ± 2 x 10^{-5}	R 6326
Q2	Crystal (control)	9.05 mc ± 1 x 10^{-4}	R 6327
R100	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R101	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R102	Resistor, depos. carbon	3 kΩ/0.25 w	WF 3 k/0,25
R103	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R104	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R105	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R106	Resistor, depos. carbon	40 kΩ/0.5 w	WF 40 k/0,5
R107	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R108	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R109	Resistor, depos. carbon	2.5 kΩ/1 w	WF 2,5 k/1
R110	Resistor, depos. carbon	200 kΩ/0.5 w	WF 200 k/0,5
R111	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R112	Resistor, depos. carbon	2 MΩ/0.25 w	WF 2 M/0,25
R113	Resistor, depos. carbon	2.5 kΩ/0.25 w	WF 2,5 k/0,25
R114	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R115	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R116	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R117	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R118	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R119	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R120	Resistor, depos. carbon	400 Ω/0.25 w	WF 400/0,25
R121	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R122	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R123	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R124	Resistor, depos. carbon	125 kΩ/0.5 w	WF 125 k/0,5
R125	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R126	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R127	Resistor, depos. carbon	160 Ω/0.25 w	WF 160/0,25
R128	Resistor, depos. carbon	40 kΩ/0.5 w	WF 40 k/0,5
R129	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R130	Resistor, depos. carbon	3 kΩ/0.25 w	WF 3 k/0,25
R131	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R132	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R133	Resistor, depos. carbon	3 kΩ/0.25 w	WF 3 k/0,25
R134	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R135	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R136	Resistor, depos. carbon	250 kΩ/0.25 w	WF 250 k/0,25
R137	Resistor, depos. carbon	1.25 MΩ/0.5 w	WF 1,25 M/0,5
R138	Resistor, depos. carbon	60 kΩ/0.5 w	WF 60 k/0,5
R139	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R140	Resistor, depos. carbon	200 kΩ ±1%/0.5 w	WF 200 k/1/0,5
R141	Resistor, depos. carbon	160 Ω/0.25 w	WF 160/0,25
R142	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R143	Resistor, depos. carbon	160 Ω/0.1 w	WF 160/0,1
R144	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R145	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R146	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1

Ref. No.	Designation	Ratings	R&S Stock No.
R148	Resistor, depos. carbon	160 Ω/0.25 w	WF 160/0,25
R149	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R150	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R151	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R152	Resistor, depos. carbon	5 kΩ/0.25 w	WF 5 k/0,25
R153	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R154	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R155	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R156	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R157	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R158	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R159	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R160	Resistor, depos. carbon	125 Ω/0.25 w	WF 125/0,25
R161	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R162	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R163	Resistor, depos. carbon	12.5 kΩ/0.25 w	WF 12,5 k/0,25
R164	Resistor, depos. carbon	3 MΩ/0.25 w	WF 3 M/0,25
R165	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R166	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R167	Resistor, depos. carbon	600 Ω ±1%/0.25 w	WF 600/1/0,25
R168	Resistor, depos. carbon	4 kΩ/0.5 w	WF 4 k/0,5
R169	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R170	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R171	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R172	Resistor, depos. carbon	500 Ω/0.25 w	WF 500/0,25
R173	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R174	Resistor, depos. carbon, variable	1 kΩ lin.	WS 9122 F/1 k

Ref. No.	Designation	Ratings	R&S Stock No.
R203	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R204	Resistor, depos. carbon	80 kΩ/0.5 w	WF 80 k/0,5
R205	Resistor, depos. carbon	60 kΩ/0.5 w	WF 60 k/0,5
R206	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R208	Resistor, depos. carbon	10 kΩ/0.25 w	WF 10k/0,25
R209	Resistor, depos. carbon	25 kΩ/0.25 w	WF 25 k/0,25
R210	Resistor, depos. carbon	60 Ω/0.25 w	WF 60/0,25
R211	Resistor, depos. carbon	60 Ω/0.25 w	WF 60/0,25
R212	Resistor, depos. carbon	10 Ω/0.25 w	WF 10/0,25
R213	Resistor, depos. carbon	400 Ω/0.1 w	WF 400/0,1
R214	Resistor, depos. carbon	10 kΩ/0.1 w	WF 10 k/0,1
R215	Resistor, depos. carbon	... /0.1 w	WF .../0,1
R216	Resistor, depos. carbon	... /0.1 w	WF .../0,1
R217	Resistor, depos. carbon	... /0.1 w	WF .../0,1
R218	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R219	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R220	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R221	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R222	Resistor, depos. carbon	25 kΩ/0.5 w	WF 25 k/0,5
R223	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R224	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R225	Resistor, depos. carbon, variable	500 kΩ lin.	WS 9122 F/500 k
R226	Resistor, depos. carbon	50 Ω/0.1 w	WF 50/0,1
R227	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R228	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R229	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1

Ref. No.	Designation	Ratings	R&S Stock No.
Rö20	Pentode		EF 80
Rö21	Pentode		EF 80
Rö22	Pentode		EF 80
Rö23	Pentode		EF 80
Rö24	Pentode		EF 80
Rö25	Pentode		EF 80
Rö26	Triode-Hexode		ECH 81
Rö27	Pentode		EF 80
Rö28	Pentode		EF 80
Rö29	Pentode		EF 80
Rö30	Triode-Hexode		ECH 81
Rö31	Triode-Hexode		ECH 81
Rö32	Pentode		EF 80
Rö33	Pentode		EF 80
Rö34	Pentode		EF 800
Rö35	Pentode		EF 800
Rö36	Pentode		EF 80
Rö37	Pentode, output		E 80 L
Rö38	Pentode, output		E 80 L
Rö39	Pentode		EF 80
Rö40	Pentode		EF 80
Rö41	Pentode		EF 80
Rö42	Pentode		EF 80
C361	Capacitor, ceramic	47 µµf	CCH 31/47
C362	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C363	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350

Ref. No.	Designation	Ratings	R&S Stock No.
C364	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C365	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C366	Capacitor, ceramic	2 µµf	CCG 41/2
C367	Capacitor, bypass, ceramic	1600 µµf/350 v	CBR 1/1600/350
C368	Capacitor, bypass, ceramic	1600 µµf/350 v	CBR 1/1600/350
C369	Capacitor, variable		444461 - 2.2
C370	Capacitor, ceramic	Test departement	CCG .../...
C371	Capacitor, ceramic	8 µµf	CCG 41/8
C372	Capacitor, ceramic	2 µµf	CCG 41/2
C373	Capacitor, ceramic	8 µµf	CCG 41/8
C374	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C375	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C376	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C377	Capacitor, bypass, ceramic	2500 µµf/350 v	CBR 1/2500/350
C378	Capacitor, ceramic	47 µµf	CCH 31/47
C379	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C380	Capacitor, bypass, ceramic	1600 µµf/350 v	CBR 1/1600/350
C381	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C382	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C383	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C384	Capacitor, bypass, ceramic	1600 µµf/350 v	CBR 1/1600/350

Ref. No.	Designation	Ratings	R&S Stock No.
C385	Capacitor, bypass, ceramic	1600 µµf/350 v	CBR 1/1600/350
C391	Capacitor, variable		444461 - 5.2
C392	Capacitor, ceramic	2 x 180 µµf 1 x 150 µµf Test department	2 x CCH 32/180 1 x CCH 32/150 CCH ... CCG ...
C393	Capacitor, variable	3...19 µµf	CV 52116
C394	Capacitor, ceramic	180 µµf	CCH 32/180
C395	Capacitor, ceramic	47 µµf	CCH 32/47
C396	Capacitor, synth. foil	50,000 µµf/250 v	CKS 50 000/250
C397	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C398	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C399	Capacitor, ceramic	47 µµf	CCH 31/47
C400	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C401	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C402	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C403	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C404	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C405	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C406	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C407	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C415	Capacitor, variable		444461 - 5.2
C416	Capacitor, ceramic	945 µµf Test departement	444462 - 5.7 CCH ... CCG ... parallel
C417	Trimmer, air	4..29 µµf	CV 8025
C418	Capacitor, ceramic	300 µµf	CCH 65/300

Ref. No.	Designation	Ratings	R&S Stock No.
C419	Capacitor, ceramic	82 µµf	CCH 62/82
C420	Capacitor, synth. foil	50,000 µµf/250 v	CKS 50 000/250
C421	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C422	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C423	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C424	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C425	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C426	Capacitor, synth. foil	2500 µµf/250 v	CKS 2500/250
C427	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C428	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C429	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C430	Capacitor, paper, feed-through	50,000 µµf/300 v	CPD 50 000/300
C431	Capacitor, synth. foil	1000 µµf/500 v	CKS 1000/500
C441	Capacitor, ceramic	10 µµf	CCG 41/10
C442	Capacitor, ceramic	47 µµf	CCH 31/47
C443	Capacitor, ceramic	47 µµf	CCH 31/47
C444	Capacitor, ceramic	47 µµf	CCH 31/47
C445	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C446	Capacitor, feed-through, ceramic	5000 µµf/500 v	CFR 1/5000/500
C447	Capacitor, MP	8 µf/160 v	CMR 8/160/2
C448	Capacitor, MP	8 µf/160 v	CMR 8/160/2
C450	Capacitor, ceramic	0...10 µµf	CCG 41/...
C451	Capacitor, variable	4...14 µµf	CDV 306010
C452	Trimmer, air	4...29 µµf	CV 8125

Ref. No.	Designation	Ratings	R&S Stock No.
C453	Capacitor, ceramic		CCH 31/...
C454	Capacitor, ceramic		CCH 31/...
C455	Trimmer, air	4...10,4 µµf	CV 8106
C456	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
C457	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C458	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C459	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C460	Capacitor, synth. foil	300 µµf/500 v	CKD 2/300/500
C461	Capacitor, ceramic	...	CCG 41/...
C462	Capacitor, paper	250,000 µµf/250 v	CPK 250 000/250
C463	Capacitor, synth. foil	250 µµf/1000 v	CKS 250/1000
C464	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C465	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C466	Capacitor, paper	50,000 µµf/250 v	CPM 50 000/250
C467	Capacitor, synth. foil	1000 µµf ±2%/500 v	CKS 1000/2/500
C468	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
C469	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
C470	Capacitor, synth. foil	300 µµf/500 v	CKD 2/300/500
C471	Capacitor, MP	8 µf/250 v	CMR 8/250
C472	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C473	Capacitor, paper	50,000 µµf/250 v	CPK 50 000/250
C474	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
C475	Capacitor, synth. foil	500 µµf/500 v	CKS 500/500
C476	Capacitor, MP	8 µf/250 v	CMR 8/250
C477	Capacitor, paper	25,000 µµf/400 v	CPK 25 000/400
C478	Capacitor, synth. foil	2500 µµf ±2%/250 v	CKS 2500/2/250
C479	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250

Ref. No.	Designation	Ratings	R&S Stock No.
C480	Capacitor, synth. foil	10,000 µµf ±2%/125 v	CKS 10 000/2/125
C481	Capacitor, synth. foil	5000 µµf ±2%/500 v	CKS 5000/2/500
C482	Capacitor, paper	100 000 µµf/250 v	CPK 100 000/250
C483	Capacitor, MP	8 µf/250 v	CMR 8/250
C484	Capacitor, paper	25,000 µµf/400 v	CPK 25 000/400
C485	Capacitor, MP	8 µf/250 v	CMR 8/250
C486	Capacitor, MP	0.25 µf/500 v	CMR 0,25/500
C487	Capacitor, synth. foil	25,000 µµf ±2%/250 v	CKS 25 000/2/250
C488	Capacitor, MP	1 µf/160 v	CMR 1/160/2
C489	Capacitor, synth. foil	25,000 µµf ±2%/250 v	CKS 25 000/2/250
C490	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C491	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C492	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C493	Capacitor, paper, feed-through	10,000 µµf/300 v	CPD 10 000/300
C495	Capacitor, paper	10,000 µµf/630 v	CPK 10 000/630
C496	Capacitor, paper	100,000 µµf/250 v	CPK 100 000/250
G121	Diode, crystal		GK 2501
G122	Diode, crystal		GK 2501
G131	Diode, crystal		GK/S 33
G132	Diode, crystal		GK/S 33
G133	Diode, crystal		GK/S 33
I1	Ammeter, moving-coil		INS 20203
I2	Ammeter, moving-coil		INS 20203
I3	Ammeter, moving-coil		INS 20201

Ref. No.	Designation	Ratings	R&S Stock No.
K1	Wire, stranded, shielded		LKK 61900
K2	Cable		R 6422/160
K3	Cable		R 6422/140
K4	Cable		R 6422/130
K5	Cable		R 6422/62
K6	Wire, stranded, shielded		LKK 61900
K7	Wire, stranded, shielded		LKK 61900
K8	Wire, stranded, shielded		LKK 61900
K9	Wire, stranded, shielded		LKK 61900
K10	Wire, stranded, shielded		LKK 61900
K11	Cable		444462 - 12/90
K12	Cable		444462 - 12/100
K13	Cable		444462 - 12/70
K14	Cable, r-f		LK 126/6
K16	Wire, stranded, shielded		LKK 61900
K17	Wire, stranded, shielded		LKK 61900
K19	Cable, r-f		
K20	Cable, r-f		
K21	Cable, r-f		
K22	Cable, r-f		
K23	Cable, shielded		LKK 92220
K24	Cable, shielded		LKK 92220
K25	Cable, shielded		LKK 92220
K26	Cable, shielded		LKK 92220
K27	Wire, twin, stranded, shielded		LFA 03022
K28	Wire, twin, stranded, shielded		LFA 03022
K29	Cable, shielded		LKK 92220

Ref. No.	Designation	Ratings	R&S Stock No.
K30	Cable, shielded		LKK 92220
K31	Cable, shielded		LKK 92220
K33	Cable, shielded		LKK 92220
L151	Coil	0,5 µH	444461 - 7.38
L152	Choke	5,2 µH	444462 - 2.9
L153	Coil	6 mH	444461 - 2.11
L154	Coil	0,5 µH	444461 - 7.38
L155	Choke	20 µH	DUF 311/20
L156	Choke, heater	2 x 2 µH	444461 - 7.45
L157	Choke, heater	2 x 2 µH	444461 - 7.45
L160	Coil (tank circuit)	90 µH	444462 - 4.2
L170	Coil	210 mH	444462 - 5.2
L171	Coil	10,5 mH	444462 - 5.3.6
L190	Coil (low-pass filter)	0,78 µH	444461 - 10.7.13
L191	Coil (low-pass filter)	0,78 µH	444461 - 10.7.13
L201	Transformer, 100 kc	2,4 mH	444462 - 18.3.1
L202	Transformer, 100 kc	2,4 mH	444462 - 18.4.1
L203	Choke	8 mH	444211 - 25
L204	Coil, 10 kc	0,2 H	444211 - 7.15
L205	Coil, 1 kc	2 H	444211 - 8.2
Q3	Crystal, vacuum	100 kc	R 6311
R251	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R252	Resistor, depos. carbon	5 kΩ/0.25 w	WF 5 k/0,25
R253	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R254	Resistor, depos. carbon	12.5 kΩ/0.1 w	WF 12,5 k/0,1
R255	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R256	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R257	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R258	Resistor, depos. carbon	12.5 kΩ/0.1 w	WF 12,5 k/0,1
R259	Resistor, depos. carbon	100 Ω/0.1 w	WF 100/0,1
R260	Resistor, depos. carbon	5 kΩ/0.25 w	WF 5 k/0,25
R261	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R262	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R263	Resistor, depos. carbon	30 kΩ/0.1 w	WF 30 k/0,1
R264	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R265	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R301	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R302	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R303	Resistor, depos. carbon	800 kΩ/0.5 w	WF 800 k/0,5
R304	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R305	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R306	Resistor, depos. carbon	300Ω/0.25 w	WF 300/0,25
R307	Resistor, depos. carbon	80 kΩ/0.5 w	WF 80 k/0,5
R308	Resistor, depos. carbon	1.6 kΩ/0.5 w	WF 1,6 k/0,5
R309	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R310	Resistor, depos. carbon	30 Ω/0.1 w	WF 30/0,1
R311	Resistor, depos. carbon	10 Ω/0.1 w	WF 10/0,1
R351	Resistor, depos. carbon	10 MΩ/0.5 w	WF 10 M/0,5
R352	Resistor, depos. carbon	200 Ω/0.1 w	WF 200/0,1
R353	Resistor, depos. carbon	300 kΩ/0.5 w	WF 300 k/0,5
R354	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5
R355	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R356	Resistor, depos. carbon	2 MΩ/0.5 w	WF 2 M/0,5

Ref. No.	Designation	Ratings		R&S Stock No.
R357	Resistor, depos. carbon	500 Ω/0.25 w		WF 500/0,25
R358	Resistor, depos. carbon	30 kΩ/0.5 w		WF 30 k/0,5
R359	Resistor, depos. carbon	20 kΩ/0.5 w		WF 20 k/0,5
R360	Resistor, depos. carbon	5 kΩ/0.5 w		WF 5 k/0,5
R361	Resistor, depos. carbon	30 Ω/0.1 w		WF 30/0,1
R399	Resistor, depos. carbon	15 Ω ± 1 %/0.1 w connected through	for 75 Ω for 50 Ω and 60 Ω	WF 15/1/0,1
R400	Resistor, depos. carbon	5 Ω/0.25 w 4 Ω/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 5/0,25 WF 4/0,25
R401	Resistor, depos. carbon	50 Ω ± 1 %/0.25 w 60 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 50/1/0,25 WF 60/1/0,25
R402	Resistor, depos. carbon	314 Ω ± 1 %/0.25 w 250 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 314/1/0,25 WF 250/1/0,25
R403	Resistor, depos. carbon	142,2 Ω ± 1 %/0.25 w 170.8 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 142,2/1/0,25 WF 170,8/1/0,25
R404	Resistor, depos. carbon	96,4 Ω ± 1 %/0.25 w 115,6 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 96,4/1/0,25 WF 115,6/1/0,25
R405	Resistor, depos. carbon	142,2 Ω ± 1 %/0.25 w 170,8 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 142,2/1/0,25 WF 170,8/1/0,25
R406	Resistor, depos. carbon	96,4 Ω ± 1 %/0.25 w 115,6 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 96,4/1/0,25 WF 115,6/1/0,25
R407	Resistor, depos. carbon	142.2 Ω ± 1 %/0.25 w 170.8 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 142,2/1/0,25 WF 170,8/1/0,25
R408	Resistor, depos. carbon	96.4 Ω ± 1 %/0.25 w 115.6 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 96,4/1/0,25 WF 115,6/1/0,25
R409	Resistor, depos. carbon	142.2 Ω ± 1 %/0.25 w 170.8 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 142,2/1/0,25 WF 170,8/1/0,25
R410	Resistor, depos. carbon	96.4 Ω ± 1 %/0.25 w 115.6 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 96,4/1/0,25 WF 115,6/1/0,25
R411	Resistor, depos. carbon	142.2 Ω ± 1 %/0.25 w 170.8 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 142,2/1/0,25 WF 170,8/1/0,25
R412	Resistor, depos. carbon	96.4 Ω ± 1 %/0.25 w 115.6 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 96,4/1/0,25 WF 115,6/1/0,25
R413	Resistor, depos. carbon	142.2 Ω ± 1 %/0.25 w 170.8 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 142,2/1/0,25 WF 170,8/1/0,25
R414	Resistor, depos. carbon	65.8 Ω ± 1 %/0.25 w 79 Ω ± 1 %/0.25 w	for 50 Ω for 60 Ω and 75 Ω	WF 65,8/1/0,25 WF 79/1/0,25
R415	Resistor, depos. carbon	10 Ω/0.1 w		WF 10/0,1
R416	Resistor, depos. carbon	10 Ω/0.1 w		WF 10/0,1
R417	Resistor, depos. carbon	40 kΩ/0.25 w		WF 40 k/0,25
R418	Resistor, depos. carbon variable	25 kΩ lin.		WS 9122 F/25 k
R419	Resistor, depos. carbon	8 kΩ/0.25 w		WF 8 k/0,25
R431	Resistor, depos. carbon variable	25 kΩ lin.		WS 7125/25 k

Ref. No.	Designation	Ratings	R&S Stock No.
R432	Resistor, depos. carbon	1 MΩ/ 1 w	WF 1 M/1
R433	Resistor, depos. carbon	4 kΩ/0.5 w	WF 4 k/0,5
R446	Resistor, depos. carbon	100 kΩ/0.1 w	WF 100 k/0,1
R447	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R448	Resistor, depos. carbon	20 Ω/0.1 w	WF 20/0,1
R450	Resistor, heater		444462 - 18.1.8
R452	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R453	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R454	Resistor, depos. carbon	250 kΩ/0.5 w	WF 250 k/0,5
R455	Resistor, depos. carbon	60 kΩ/0.5 w	WF 60 k/0,5
R456	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R457	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R458	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R459	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R460	Resistor, depos. carbon	125 Ω/0.25 w	WF 125/0,25
R461	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R462	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R463	Resistor, depos. carbon	160 kΩ/0.5 w	WF 160 k/0,5
R464	Resistor, depos. carbon	8 kΩ/0.5 w	WF 8 k/0,5
R465	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R466	Resistor, depos. carbon	500 kΩ/0.5 w	WF 500 k/0,5
R467	Resistor, depos. carbon	2 MΩ/0.5 w	WF 2 M/0,5
R468	Resistor, depos. carbon	60 kΩ/0.5 w	WF 60 k/0,5
R469	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R470	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R471	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R472	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R473	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R474	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R475	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R476	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R477	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R478	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R479	Resistor, depos. carbon	400 kΩ/0.25 w	WF 400 k/0,25
R480	Resistor, depos. carbon	12.5 kΩ/1 w	WF 12,5 k/1
R481	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R482	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R483	Resistor, depos. carbon	300 kΩ/0.5 w	WF 300 k/0,5
R484	Resistor, depos. carbon	10 kΩ/0.25 w	WF 10 k/0,25
R485	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R486	Resistor, depos. carbon	1 MΩ/0.5 w	WF 1 M/0,5
R487	Resistor, depos. carbon	125 Ω/0.5 w	WF 125/0,5
R488	Resistor, depos. carbon	300 kΩ/0.5 w	WF 300 k/0,5
R490	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R491	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R492	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R494	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R495	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R496	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R497	Resistor, depos. carbon	250 kΩ/0.25 w	WF 250 k/0,25
Rl1	Miniature glow lamp	Without series resistor	RL 210 B
Rö46	Pentode		EF 800
Rö47	Duo-triode		E 88 CC

Ref. No.	Designation	Ratings	R&S Stock No.
R648	Pentode		EF 800
R651	Pentode		EF 80
R652	Pentode		EF 80
R656	Pentode		EF 80
R657	Pentode		EF 80
R661	Pentode		EF 800
R662	Pentode		EF 80
R663	Pentode		EF 80
R664	Pentode		EF 80
R665	Pentode		EF 80
R666	Pentode		EF 80
R667	Pentode, output		E 80 L
RsT	Thermometer, contact		4421 - 8.3.2/60° C
S1	Switch, wafer		SRW 13230
S2	Switch, wafer		SRN 325/32

Table of Replaceable Parts for Power Supply for Frequency Synthesizer Type XNA BN 444 911

Ref. No.	Designation	Ratings	R&S Stock No.
C1	Capacitor, MP	8 µf/750 v	CMR 8/750
C2	Capacitor, MP	8 µf/750 v	CMR 8/750
C4	Capacitor, MP	4 µf/750 v	CMR 4/750
C5	Capacitor, MP	4 µf/750 v	CMR 4/750
C6	Capacitor, MP	4 µf/750 v	CMR 4/750
C7	Capacitor, MP	0.5 µf/250 v	CMR 0,5/250/2
C8	Capacitor, MP	16 µf/250 v	CMR 16/250
C9	Capacitor, MP	16 µf/500 v	CMR 16/500
C11	Capacitor, MP	4 µf/500 v	CMR 4/500
C12	Capacitor, MP	4 µf/500 v	CMR 4/500
C13	Capacitor, MP	4 µf/350 v	CMR 4/350
C14	Capacitor, MP	0.5 µf/250 v	CMR 0,5/250/2
C15	Capacitor, MP	16 µf/250 v	CMR 16/250
G11	Rectifier, power	300 v/250 ma	GNV 11/300/250 B
G12	Rectifier, power	300 v/250 ma	GNV 11/300/250 B
G13	Rectifier, power	300 v/250 ma	GNV 11/300/250 B
G14	Rectifier, power	300 v/250 ma	GNV 11/300/250 B
G15	Rectifier, meter		GP 101
I1	Ammeter, moving-coil		INS 20502
L1	Choke, power		DB 75/2
L2	Choke, power		DB 75/2
R1	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R2	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25

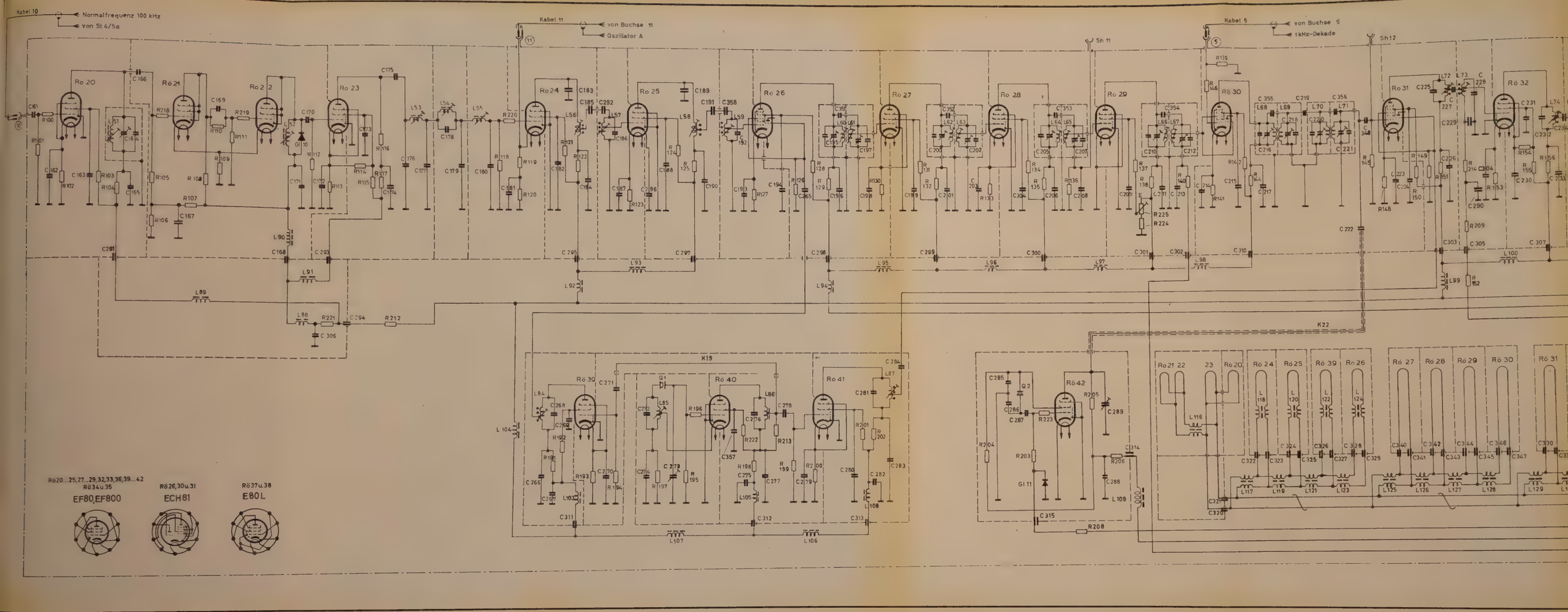
Ref. No.	Designation	Ratings	R&S Stock No.
R3	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R4	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R5	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R6	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R7	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R8	Resistor, depos. carbon	500 kΩ/1 w	WF 500 k/1
R9	Resistor, depos. carbon	40 kΩ/1 w	WF 40 k/1
R10	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R11	Resistor, depos. carbon	500 kΩ ±1%/0.5 w	WF 500 k/1/0,5
R12	Resistor, depos. carbon	300 kΩ ±1%/0.5 w	WF 300 k/1/0,5
R13	Resistor, depos. carbon	300 kΩ ±1%/0.5 w	WF 300 k/1/0,5
R14	Resistor, depos. carbon	40 kΩ ±1%/0.25 w	WF 40 k/1/0,25
R15	Resistor, depos. carbon, variable	100 kΩ lin.	WS 9122 F/100 k
R16	Resistor, wire-wound	10 Ω/0.5 w	WD 10/0,5
R17	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R18	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R19	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R20	Resistor, depos. carbon	50 kΩ/0.25 w	WF 50 k/0,25
R21	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R22	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R23	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R24	Resistor, depos. carbon	500 kΩ/1 w	WF 500 k/1
R25	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R26	Resistor, depos. carbon	16 kΩ/0.5 w	WF 16 k/0,5
R27	Resistor, depos. carbon	400 kΩ ±1%/0.5 w	WF 400 k/1/0,5
R28	Resistor, wire-wound	1 kΩ/4 w	WD 1 k/4
R29	Resistor, depos. carbon	300 kΩ ±1%/0.5 w	WF 300 k/1/0,5

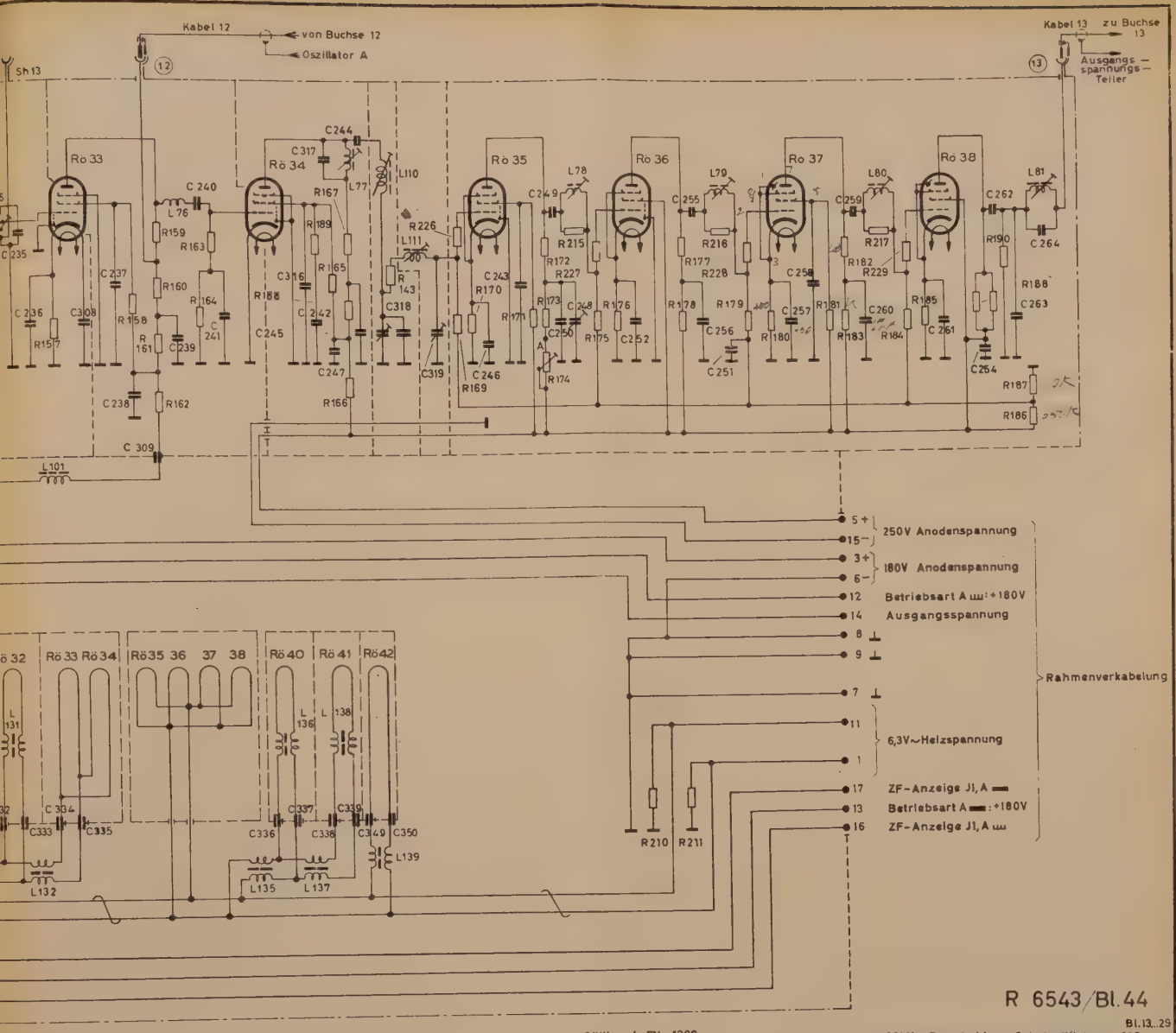
Ref. No.	Designation	Ratings	R&S Stock No.
R50	Resistor, depos. carbon, variable	100 kΩ lin.	WS 9122 F/100 k
R51	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R52	Resistor, depos. carbon	1 kΩ/0.1 w	WF 1 k/0,1
R53	Resistor, depos. carbon	5 kΩ/0.25 w	WF 5 k/0,25
R54	Resistor, depos. carbon	300 kΩ ±1%/1 w	WF 300 k/1/1
R55	Resistor, depos. carbon	5 kΩ ±1%/0.5 w	WF 5 k/1/0,5
R56	Resistor, depos. carbon	5 kΩ/0.25 w	WF 5 k/0,25
R57	Resistor, depos. carbon	25 kΩ ±1%/0.5 w	WF 25 k/1/0,5
R58	Resistor, depos. carbon	200 kΩ ±1%/1 w	WF 200 k/1/1
R59	Resistor, depos. carbon	300 Ω/0.25 w	WF 300/0,25
R11	Lamp, glow	220 v	RL 210
R51	Pentode, output		EL 34
R52	Pentode, output		EL 34
R55	Pentode, output		EL 34
R54	Pentode		EF 800
R55	Reference tube		85 A 2
R56	Pentode, output		EL 34
R57	Pentode, output		EL 34
R58	Pentode, output		EL 34
R59	Pentode		EF 800
R510	Reference tube		85 A 2
S1	Switch (combination)		BRK 1
S2	Switch, wafer		BRW 15529
S3	Fuse strip		FD 60515
S4	Fuse strip		FD 60515

Ref. No.	Designation	Ratings	R&S Stock No.
S5	Fuse strip		FD 60515
S6	Fuse strip		FD 60515
Si1	Fuse	1 amp	1 C DIN 41571
Si2	Fuse	1 amp	1 C DIN 41571
Si3	Fuse	1 amp	1 C DIN 41571
Si4	Fuse	1 amp	1 C DIN 41571
Tr1	Transformer, power		444911 - 15/2
Tr2	Transformer, power		444911 - 16/2
Tr3	Transformer, power		444911 - 17/2
Tr4	Transformer, power		444911 - 18/2

Table of Replaceable Parts for Cabinet rack for Decade Frequency Measuring System Type XZA BN 444043

Ref. No.	Designation	Ratings	R&S Stock No.
K1	Cable, r-f		LKK 61 900
K2	Cable, r-f		LKK 61 900
K3	Cable, r-f		LKK 61 900
K4	Cable, r-f		LKK 61 900
K5	Cable, r-f		LKK 61 900
K6	Cable, r-f		LKK 61 900
K7	Cable, two-wire, shielded		LFA 03022
Mo1	Blower		ZV 14/11
S2	Switch assembly		SR 634
S3	Switch, toggle, r-f		SR 301/2


Kabel 10
Normalfrequenz 100 kHz
von St 4/5a
Kabel 11
von Buchse 11
Oszillator A
Kabel 5
von Buchse 5
1kHz-Dekade
Sh 11
Sh 12
Ro 20
Ro 21
Ro 22
Ro 23
Ro 24
Ro 25
Ro 26
Ro 27
Ro 28
Ro 29
Rö 30
Ro 31
Rö 32
K19
Rö 39
Rö 40
Ro 41
K22
Rö 42
Gl 10
Gl 11
Rö20...25,27...29,32,33,36,39...42
Rö34u.35
EF80,EF800
Rö26,30u.31
ECH81
Rö37u.38
E80L



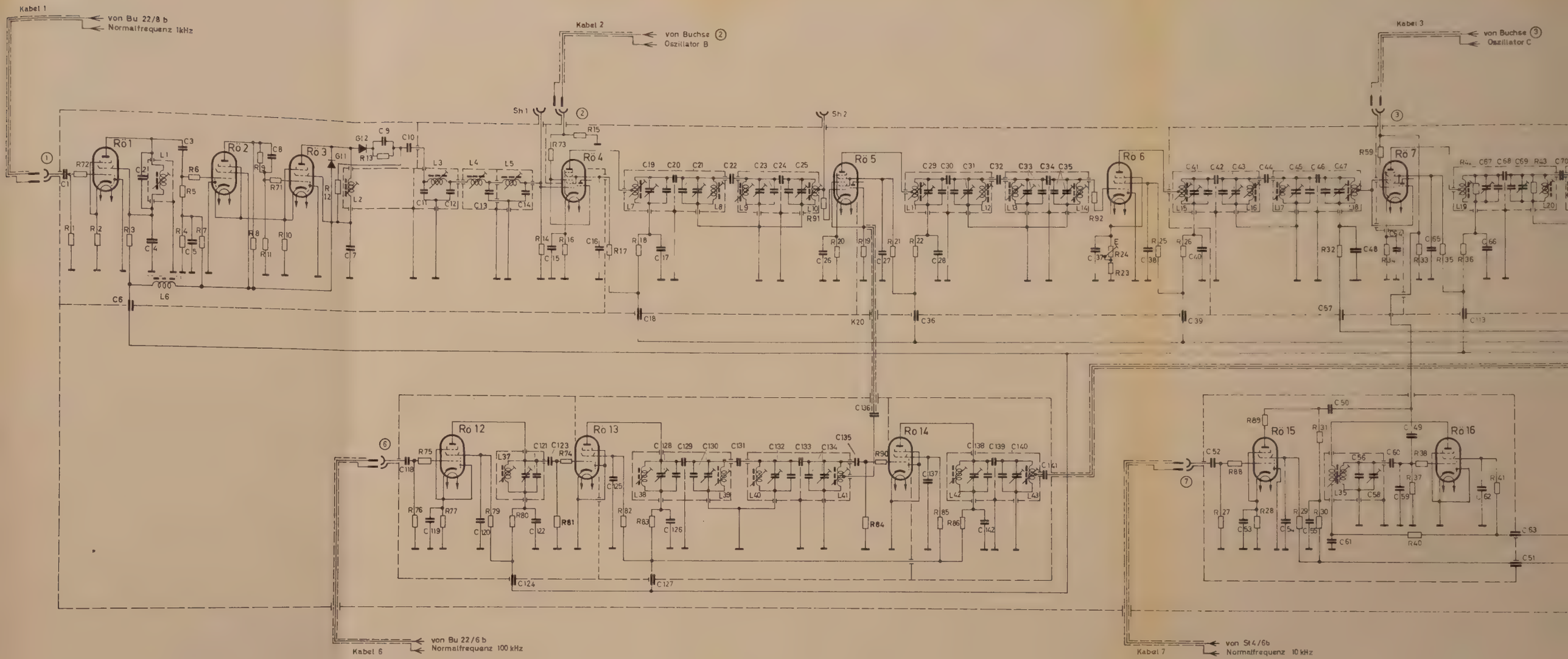
R 6543/Bl. 44

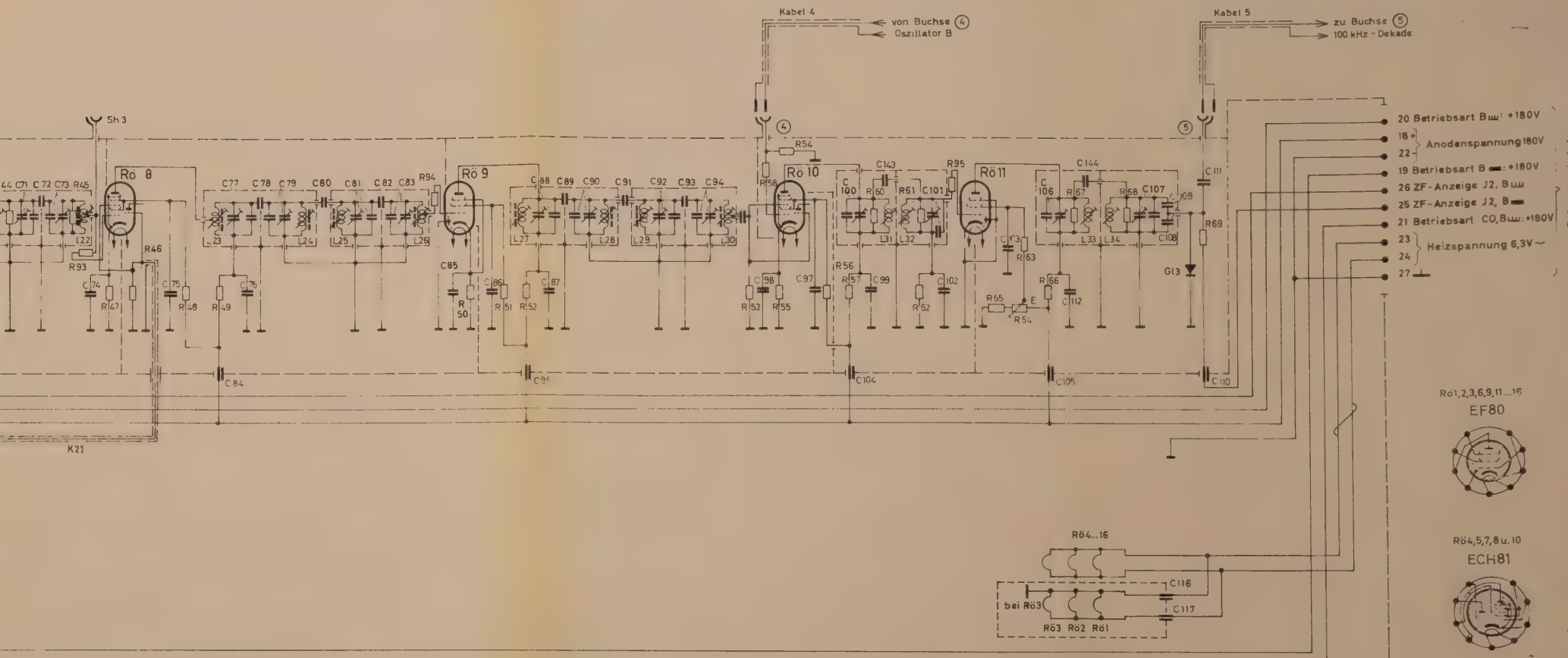
Bl. 13...29

Gültig ab FNr. 1308

100kHz-Dekade, hierzu Schaltteilliste 444462Sa

Stromlauf zu		Zeichn. Nr.
Normalfrequenzgenerator	Type XUA	444462S Bl. 2


Kabel 1
von Bu 22/8 b
Normalfrequenz 1kHz
Kabel 2
von Buchse (2)
Oszillator B
Kabel 3
von Buchse (3)
Oszillator C
Sh 1
Sh 2
Rö 1
Rö 2
Rö 3
Rö 4
Rö 5
Rö 6
Rö 7
Rö 12
Rö 13
Rö 14
Rö 15
Rö 16
Kabel 6
von Bu 22/6 b
Normalfrequenz 100 kHz
Kabel 7
von St 4/6b
Normalfrequenz 10 kHz



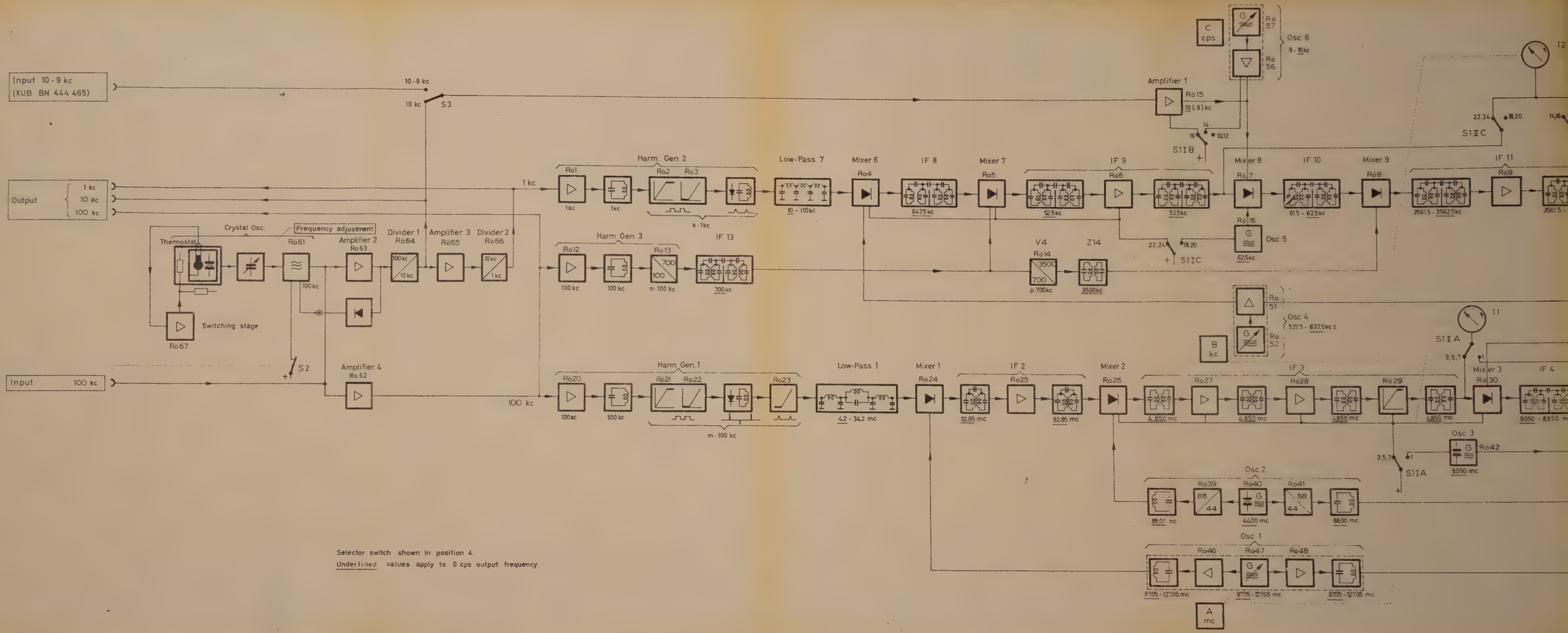
Gültig ab FNr. 1308

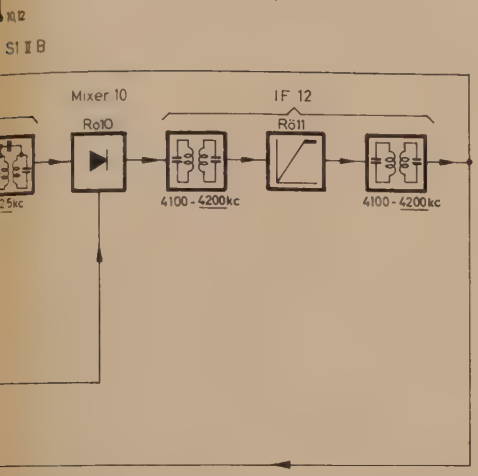
R 6543 Bl. 43

Gesamtstromlauf besteht aus 3 Blatt.

1 kHz - Dekade; hierzu Schaltteilliste 444462 Sa Bl. 1...12

Stromlauf zu		Zeichn. Nr.
Normalfrequenzgenerator	Type XUA	444462 S Bl. 1


Input 10 - 9 kc
(XUB BN 444 465)
10 - 9 kc
10 kc
S3
Output
1 kc
10 kc
100 kc
Crystal Osc.
Frequency adjustment
Thermostat
Rö61
Amplifier 2
Rö63
Divider 1
Rö64
Amplifier 3
Rö65
Divider 2
Rö66
100 kc
10 kc
1 kc
Switching stage
Rö67
Input 100 kc
S2
Amplifier 4
Rö62
100 kc
Harm. Gen. 2
Ro1
Ro2
Ro3
1 kc
k · 1 kc
Harm. Gen. 3
Ro12
Ro13
100 kc
n · 100 kc
IF 13
700 kc
Harm. Gen. 1
Ro20
Ro21
Ro22
Ro23
m · 100 kc
Low-Pass 7
10 - 110 kc
Low-Pass 1
4.2 - 34.2 mc
Mixer 6
Ro4
Mixer 7
Ro5
Mixer 1
Ro24
Mixer 2
Ro26
Mixer 8
Ro7
Mixer 9
Ro8
Mixer 3
Ro30
IF 8
6475 kc
IF 9
Ro6
525 kc
IF 10
61.5 - 62.5 kc
IF 11
3561.5 - 3562.5 kc
IF 4
9050 - 8950 kc
IF 2
92.85 mc
IF 3
4.850 mc
Amplifier 1
Rö15
10 (-9) kc
S1IB
S1IC
S1IA
S1IIA
S1IIC
V4
Rö14
3500
700
p 700 kc
Z14
3500 kc
Osc 5
Rö16
625 kc
Osc 6
9 - 10 kc
Rö 57
Rö 56
C
cps
Osc 4
537.5 - 637.5 kc
Ro 51
Ro 52
B
kc
Osc 3
Ro42
9050 mc
Osc 2
Ro39
Ro40
Ro41
88
44
4400 mc
88.00 mc
Osc 1
Ro46
Ro47
Ro48
9705 - 12705 mc
A
mc
I1
I2
Selector switch shown in position 4.
Underlined values apply to 0 cps output frequency.

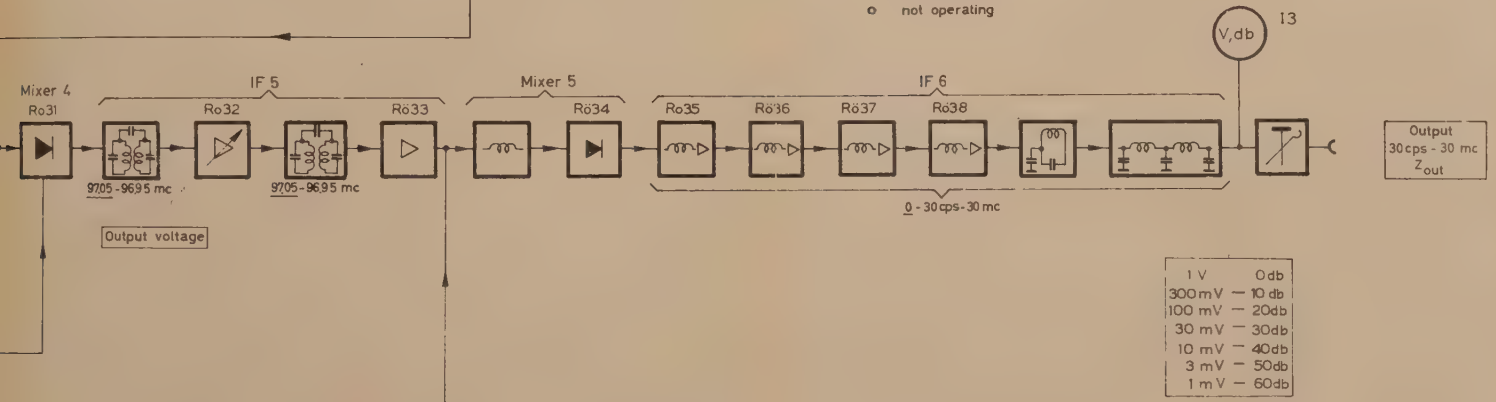


Selector switch

		A	B	C	I	II	III	IV
Switch position					1	2	3	4
S1 I A	1							
	3,5,7							
S1 I B	10,12							
	14							
	16							
S1 I C	18,20							
	22,24							
S1 II A	1							
	3,5,7							
S1 II B	10,12							
	14,16							
S1 II C	18,20							
	22,24							

Shaded field: Contacts closed

▬ free-running (cont. adj.)
⊔⊔ lock-tuned
o not operating



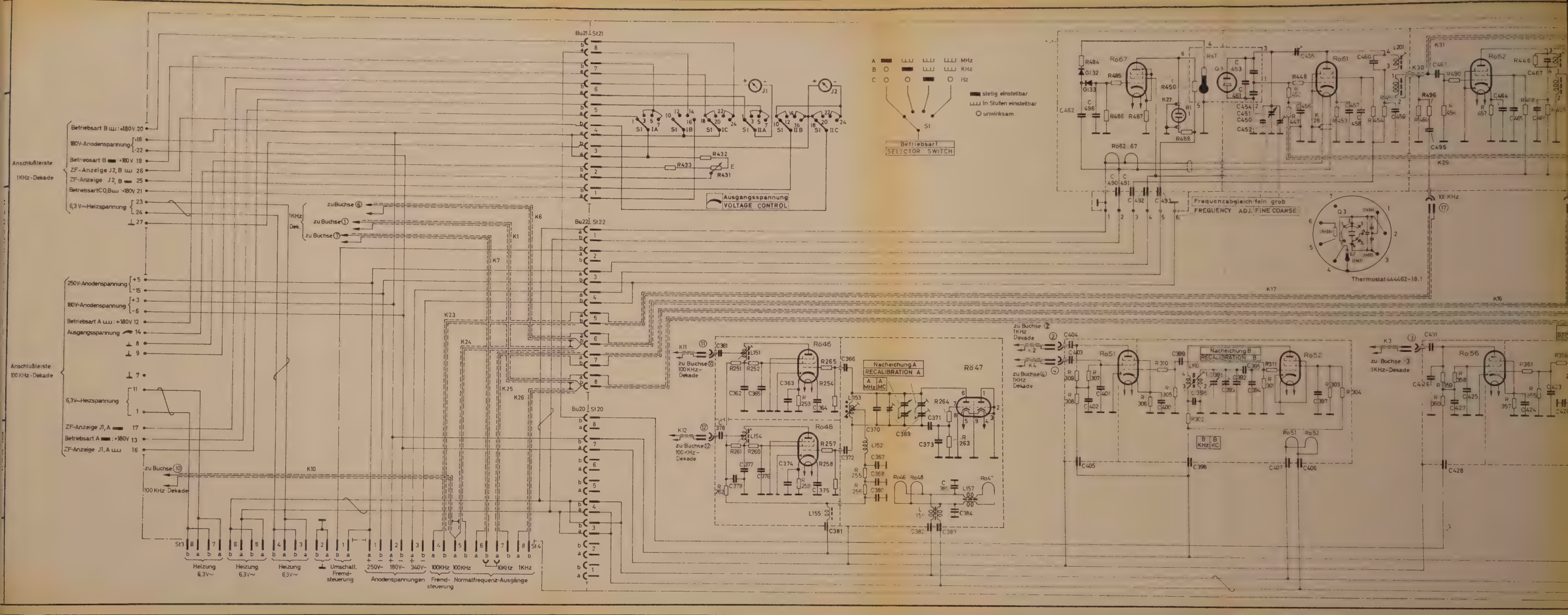
1 V	0 db
300 mV	— 10 db
100 mV	— 20 db
30 mV	— 30 db
10 mV	— 40 db
3 mV	— 50 db
1 mV	— 60 db

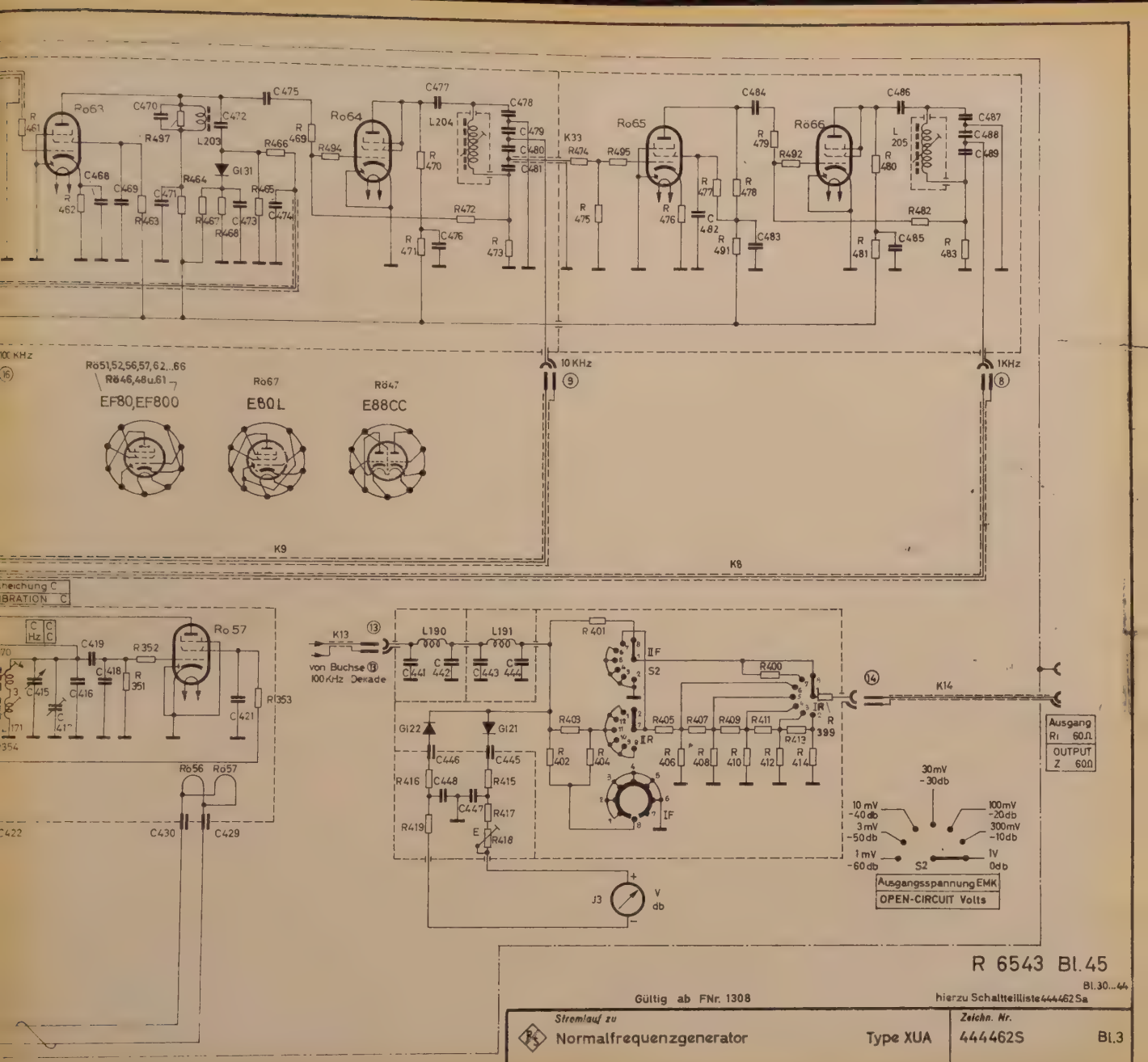
R 6542 E Bl. 2

only valid for FNr. 1308 and higher

Functional Diagram II
Frequency Synthesizer Type XUA BN 444 462

Zeichn. Nr.
444462 A Bl. 2


Anschlußleiste 1KHz-Dekade
Betriebsart B ⎓ : +180V 20
180V-Anodenspannung +18 -22
Betriebsart B ▬ : +180V 19
ZF-Anzeige J2, B ⎓ 26
ZF-Anzeige J2, B ▬ 25
Betriebsart C0, B⎓ : +180V 21
6,3 V~-Heizspannung 23 24
27
Anschlußleiste 100 KHz-Dekade
250V-Anodenspannung +5 -15
180V-Anodenspannung +3 -6
Betriebsart A ⎓ : +180V 12
Ausgangsspannung 14
8
9
7
6,3V~-Heizspannung 11 1
ZF-Anzeige J1, A ▬ 17
Betriebsart A ▬ : +180V 13
ZF-Anzeige J1, A ⎓ 16
zu Buchse 10
100 KHz Dekade
K10
1KHz Dek.
zu Buchse 6
zu Buchse 1
zu Buchse 7
K6
K1
K7
K23
K24
K25
K26
Bu21 St21
Bu22 St22
Bu20 St20
St3
St4
Heizung 6,3V~
Heizung 6,3V~
Heizung 6,3V~
Umschalt. Fremd-steuerung
250V~
180V~
340V~
Anodenspannungen
100KHz
100KHz
Fremd-steuerung
10KHz
1KHz
Normalfrequenz-Ausgänge
S1 1A
S1 1B
S1 1C
S1 IIA
S1 IIB
S1 IIC
J1
J2
R432
R433
R431
E
Ausgangsspannung VOLTAGE CONTROL
A
B
C
MHz
KHz
Hz
stetig einstellbar
in Stufen einstellbar
unwirksam
S1
Betriebsart SELECTOR SWITCH
Ro67
Ro62 67
Ro61
Ro62
K27
K28
K29
K30
K31
K17
K16
Frequenzabgleich fein grob
FREQUENCY ADJ. FINE COARSE
100 KHz
Thermostat 444462-18.1
K11
K12
zu Buchse 11 100 KHz-Dekade
zu Buchse 12 100 KHz-Dekade
Ro46
Ro47
Ro48
Nacheichung A
RECALIBRATION A
zu Buchse 2 1KHz Dekade
zu Buchse 4 1KHz Dekade
Ro51
Ro52
Nacheichung B
RECALIBRATION B
K3
zu Buchse 3 1KHz-Dekade
Ro56



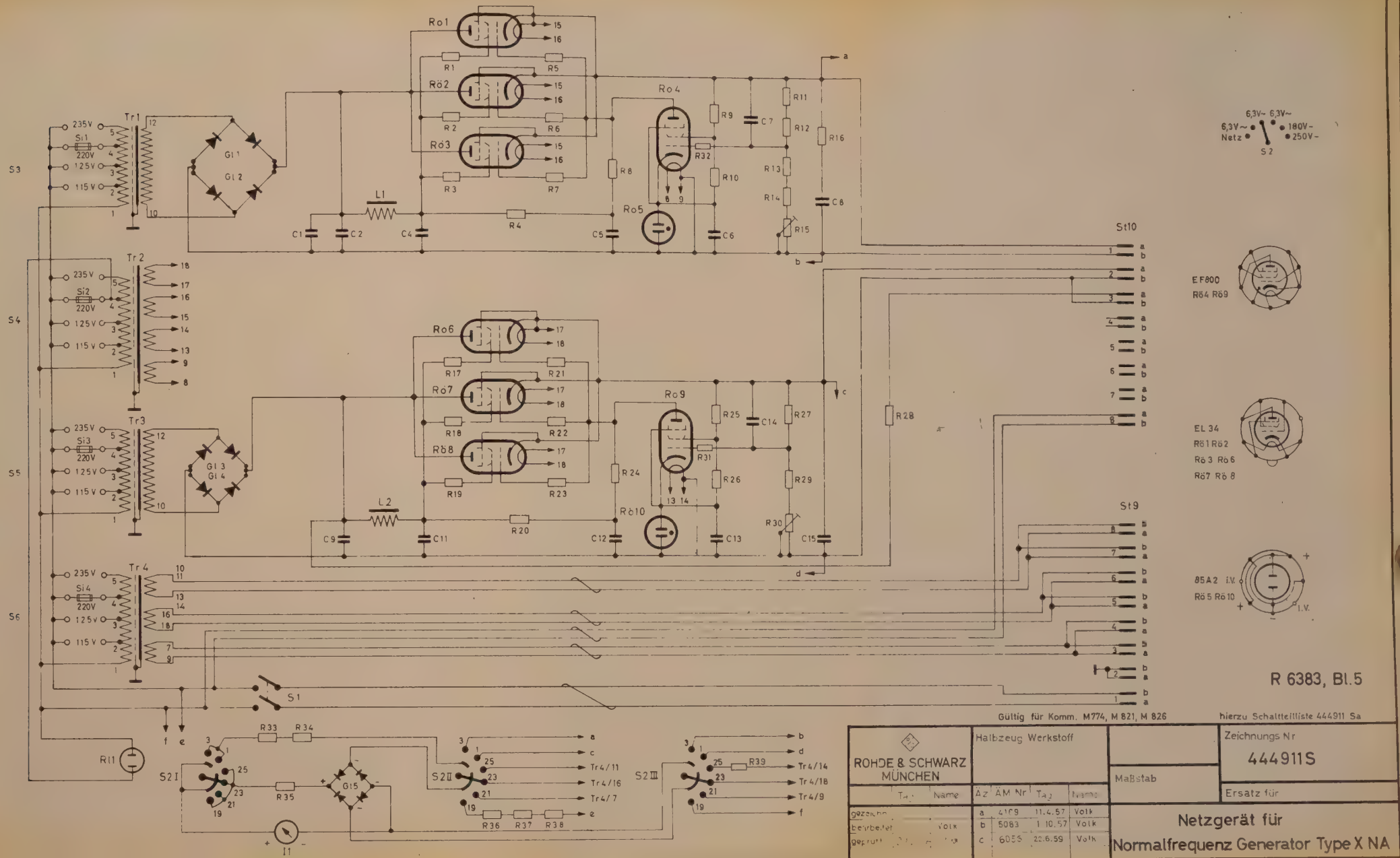
R 6543 Bl. 45

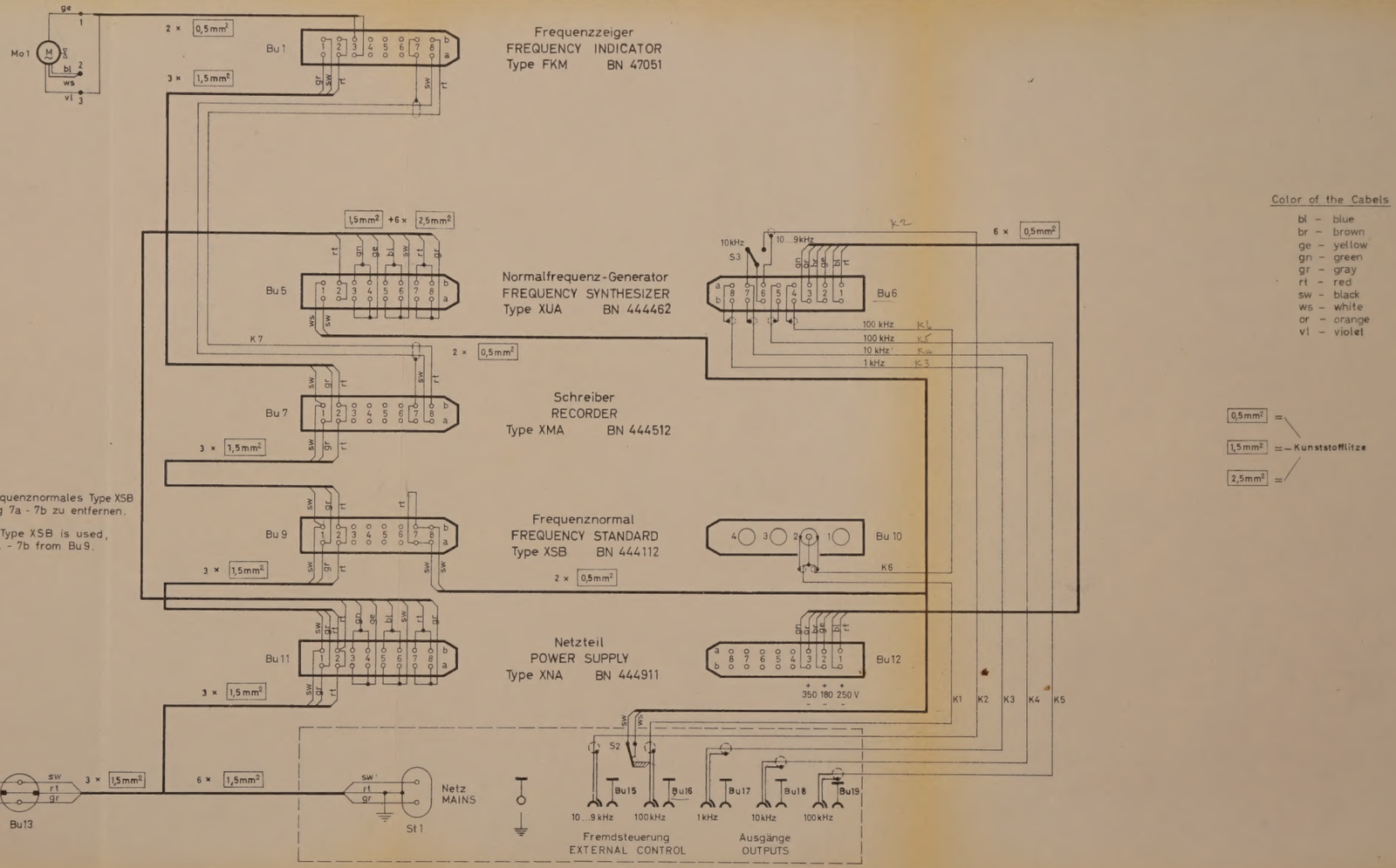
Bl. 30...44

Gültig ab FNr. 1308

hierzu Schaltteilliste 444462 Sa

Stromlauf zu	Type XUA	Zeichn. Nr.	
Normalfrequenzgenerator		444462S	Bl. 3


Ro1
Rö2
Rö3
Ro4
Ro5
Ro6
Rö7
Rö8
Ro9
Rö10
Tr1
Tr2
Tr3
Tr4
Gl1
Gl2
Gl3
Gl4
Si1 220V
Si2 220V
Si3 220V
Si4 220V
235V
125V
115V
S1
S2 I
S2 II
S2 III
S3
S4
S5
S6
R11
G15
I1
L1
L2
St10
St9
6,3V~ Netz
6,3V~ 6,3V~
180V~
250V~
S2
EF800
R64 R69
EL 34
R61 R62
Rö3 Rö6
Rö7 Rö8
85A2 i.V.
Rö5 Rö10
i.V.
R 6383, Bl.5
Gültig für Komm. M774, M 821, M 826
hierzu Schaltteilliste 444911 Sa
ROHDE & SCHWARZ MÜNCHEN
Halbzeug Werkstoff
Maßstab
Zeichnungs Nr
444911S
Ersatz für
Netzgerät für
Normalfrequenz Generator Type X NA
gezeichn.
bearbeitet Volk
geprüft
a 4109 11.4.57 Volk
b 5083 1.10.57 Volk
c 6055 22.6.59 Volk



Achtung: Bei Verwendung eines Frequenznormales Type XSB ist an Bu 9 die Verbindung 7a - 7b zu entfernen.

Caution: If a Frequency Standard Type XSB is used, remove the connection 7a - 7b from Bu 9.

Color of the Cabels

- bl – blue
- br – brown
- ge – yellow
- gn – green
- gr – gray
- rt – red
- sw – black
- ws – white
- or – orange
- vi – violet

0,5mm² = 1,5mm² = 2,5mm² = Kunststoffitze

R 6788 Bl.2

Hierzu Schaltteilliste NG 8 Sa

Stromlauf zu: Kastengestell zur Frequenzmeßanlage Type XZA BN 444 043

Zeichn. Nr. NG 6 S

ROHDE & SCHWARZ · MÜNCHEN